

APPENDIX A

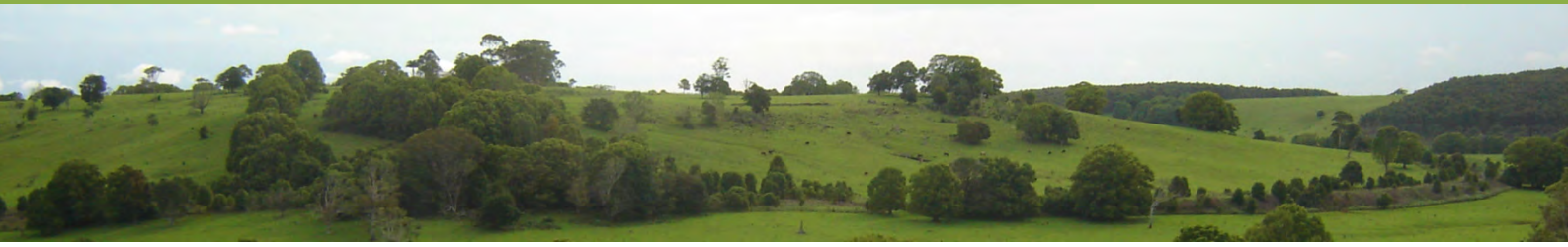
State Environmental Planning Policy Assessment

State Environmental Planning Policy	Applies?	Comments
SEPP 1 Development Standards	N	-
SEPP 14 Coastal Wetlands	N	There is no SEPP 14 Wetland within or adjacent to the site. The nearest is located at least 200m to the north-east of the eastern end of the runway. Development of the Council-owned land parcels will not directly nor indirectly impact this wetland.
SEPP 15 Rural Landsharing Communities	N	-
SEPP 21 Caravan Parks	N	-
SEPP 26 Littoral Rainforests	N	There is no SEPP26 littoral rainforest within or adjacent to the site.
SEPP 30 Intensive Agriculture	N	-
SEPP 32 Urban Consolidation (Redevelopment of Urban Land)	N	-
SEPP 33 Hazardous and Offensive Development	N	-
SEPP 36 Manufactured Home Estates	N	-
SEPP 44 Koala Habitat Protection	Y	The ecological assessment undertaken by Council indicates that the site contains 'potential' and 'core' koala habitat. The area is included within the draft Byron Coast Koala Plan of Management. In accordance with the provisions of that Plan, the site is within the Tyagarah-Myocum Koala Management Precinct (KMP). Development of the land will comply with the relevant provisions of the draft KPOM. In particular, it is proposed that the main area of Koala habitat will be contained in one new lot, which will be retained by Council as 'Community Land' for conservation purposes.
SEPP 50 Canal Estate Development	N	-
SEPP 55 Remediation of Land	Y	A preliminary soil assessment has been undertaken in accordance with the requirement of this SEPP. The assessment report is attached as Appendix B to this Planning Proposal. It concludes that, based on the known history of the site, inspection of the site and the sampling regime undertaken, further soil contamination assessment is not required in the investigation area.
SEPP 62 Sustainable Agriculture	N	-
SEPP 64 Advertising & Signage	N	-
SEPP 65 Design Quality of Residential Flat Development	N	-

State Environmental Planning Policy	Applies?	Comments
SEPP 71 Coastal Protection	Y	The site is located within the Coastal Zone. It is, however, located well landward of the coastal erosion zones identified in Council's DCP. The location is such that development of the land will have no effect on public access to the foreshore, nor result in the overshadowing of any foreshore area.
SEPP (Affordable Rental Housing) 2009	N	-
SEPP (Building Sustainability Index: BASIX) 2004	N	-
SEPP (Exempt and Complying Codes) 2008	N	The development of the land for airfield related and associated facilities does not meet the requirements for either exempt or complying development under this SEPP.
SEPP (Housing for Seniors or People with a Disability) 2004	N	-
SEPP (Infrastructure) 2007	N	Clauses 21-23 of the SEPP relate to Air Transport Facilities, and contains the same definitions adopted by BLEP 2014. This section allows that development for either an <i>airport</i> of a <i>heliport</i> may be carried out by a public authority on land within the RU2 zone (and other nominated zones).
SEPP (Major Development) 2005	N	-
SEPP (Mining, Petroleum Production and Extractive Industries) 2007	N	-
SEPP (Miscellaneous Consent Provisions) 2007	N	-
SEPP (Rural Lands) 2008	Y	The planning principles contained in this SEPP are aimed at protecting agricultural and other productive and sustainable economic activities in rural areas, and protecting natural resources, including biodiversity, water resources and the like. The subject land does not have significant agricultural potential and has been used for some time as an airfield with aviation-related ancillary uses. As outlined above, the concept development has been designed to minimise biodiversity impacts and ensure the ongoing retention of important koala habitat on the site. The planning proposal is therefore not inconsistent with the Rural Planning Principles outlines in this SEPP.
SEPP (State and Regional Development) 2011	N	-

APPENDIX B

SEPP 55 Assessment



PRELIMINARY CONTAMINATED LAND ASSESSMENT
For

The Proposed Subdivision

of

**Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 &
Lot 49 DP 881232
Yarin Lane, Tyagarah**

For

Byron Shire Council

Report Number: 15112_sepp55
Date: 19th March 2015

Table of Contents

EXECUTIVE SUMMARY	3
1 INTRODUCTION	4
2 SCOPE OF WORK	4
3 SITE IDENTIFICATION.....	5
4 HISTORY OF SITE	5
5 SITE CONDITION AND SURROUNDING ENVIRONMENT	8
5.1 Site Investigation.....	8
5.2 General Site Condition	8
5.3 Signs of Contamination	8
6 GEOLOGY AND SOIL	8
7 SAMPLING METHODOLOGY	9
8 BASIS FOR ASSESSMENT CRITERIA	10
8.1 Health Investigation Levels	10
8.2 Ecological Investigation Levels.....	11
9 RESULTS.....	11
9.1 Interpretation of Results	11
10 CONCLUSION.....	12
11 REFERENCES	13
APPENDICIES	14
CHAIN OF CUSTODY	14
LABORATORY ANALYSIS RESULTS	15
APPENDIX A – SUBDIVISION PLAN	16

- Exhibit No. 1 – Site locality plan
- Exhibit No. 2 – Sample locations
- Exhibit No. 3 – Site Conceptual model

EXECUTIVE SUMMARY

Greg Alderson and Associates have been commissioned by Byron Shire Council to undertake a preliminary contaminated land assessment at Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah. This assessment is required to determine that the subject allotments are suitable for the proposed development, being the subdivision of the existing six allotments into 16 new allotments. As required under Section 7 of SEPP 55, this assessment was conducted to determine if the site was contaminated from past or present land uses.

Staff of this office inspected the site as part of the assessment of any potential contamination.

To ensure that the site was not contaminated, a preliminary soil contamination assessment (Tier 1) was undertaken in accordance with NEPM 1999 (2013), DUAP and EPA (1998) and NSW EPA (1995) within the areas that will experience a change of sensitivity and use from the proposed subdivision. Soil adjacent to existing buildings, fuel storage tanks and hangers was not investigated as the existing buildings and infrastructure present in the subdivision area is proposed to continue in its current use following the subdivision. Soil sampling was undertaken in the area of proposed change in use and adjacent to the airstrip to determine if there was widespread contamination of the proposed subdivision area from the use of the airfield.

Three composite soil samples were collected in the investigation area. Samples were analysed for heavy metals (including arsenic, lead, zinc and copper), organochlorines (including DDT and aldrin/dieldrin) and organophosphorous, which were considered to be the most likely chemicals used on an agricultural property or associated with long term use of the airfield. The sampling results were compared to adjusted Health Investigation Levels (HILs) and Ecological Investigation Levels (EILs) from NEPM 1999 (2013).

The results showed all were below the relevant HILs and EILs.

Based on the known history of the site, inspection of the site and sampling regime, it is concluded that further soil contamination assessment is not required in the investigation area. NSW EPA (1995) & NEPM 1999 (2013) state that if the contaminant concentration of the site is below a threshold limit and there is no indication that further investigation is required, the site can be considered as uncontaminated and this is considered to be the case on this site.

1 INTRODUCTION

Greg Alderson and Associates have been commissioned by Byron Shire Council to undertake a preliminary contaminated land assessment at Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah. This assessment is required to determine that the area of the subject existing lots is suitable for subdivision into industrial and commercial use. As required under Section 7 of SEPP 55, this assessment was conducted to determine if the site was contaminated from past or present land uses. Soil testing was undertaken in the proposed development location to assist in the detection and assessment of possible contamination. The site was assessed for contamination in accordance with the requirements of the National Environmental Protection Measure 1999 (2013) (NEPM).

The proposed allotments that will experience a change in use as shown in **Exhibit No. 2** were classed as the investigation area for this assessment. As the proposed allotments that contain the existing uses and buildings will not experience any change in use or sensitivity, no investigation was conducted adjacent to those buildings.

2 SCOPE OF WORK

This investigation is Tier 1 - preliminary site investigation, which is required to determine if contamination of the site's soil has occurred from past land usage in accordance with NEPM 1999 (2013), DUAP and EPA (1998). The investigation includes obtaining a history of land usage on the site and a preliminary soil-sampling regime. The results of the soil sample analysis are compared with the Health Investigation Levels (HIL's) and Ecological Investigation Levels (EIL's) outlined in NEPM 1999 (2013) and have been adjusted for composite soil sampling. If the sample results are above the relevant HILs or EILs a detailed investigation will be required in accordance with NEPM 1999 (2013) & NSW EPA (2000).

The relevant guidelines used for the investigation are as follows:

- Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (1992);
- NSW EPA (1995) Contaminated Sites – Sampling Design Guidelines;
- National Environmental Protection Measure 1999 (2013);
- NSW EPA (2000) Guidelines for Consultants Reporting Contaminated Sites.

Soil sampling methodology used in this investigation included:

- Soil analysis tests were undertaken to determine the presence of heavy metals, organochlorines and organophosphorous;
- All soil sampling was undertaken by Dylan Brooks (BEnvSc) and Wendy Attrill (BAppSc) of this office, using composite soil sampling of the sites topsoil at intervals of a maximum 20m;
- All samples were collected using a hand auger, placed in a plastic bag and delivered to Richmond Water Laboratories (RWL) who undertook analysis for the investigation for heavy metals and subcontracted to Envirolab for analysis of OrganoChlorines (OCs) and OrganoPhosphorus (OPs);
- All results from RWL were sent to this office for the completion of this report;
- Results were compared with NEPM HIL's according to 'Commercial/industrial D' sensitivity and also EILs calculated from NEPM for 'aged' contamination;
- The site was assessed in accordance with the Tier 1 requirements of NEPM 1999 (2013);
- The report is written in accordance with the relevant chapters of NSW EPA (2000) Guidelines for Consultants Reporting Contaminates Sites.

3 SITE IDENTIFICATION

The site is formally known as Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah. The proposed subdivision plan is presented as an appendix.

4 HISTORY OF SITE

A 1912 parish map (Figure 1) shows that the now highway was established adjacent to the subject sites. The subject area proposed for subdivision is noted to be portion 165 and 181, being a 40 acre portion. Broad area ground disturbance may have occurred following drainage works as the parish map shows a drain proposal to the north of the investigation area, but it is generally understood that the whole area experienced drainage works. The 1938 parish map (Figure 2) shows a change in grantee however the portion boundaries had not changed.

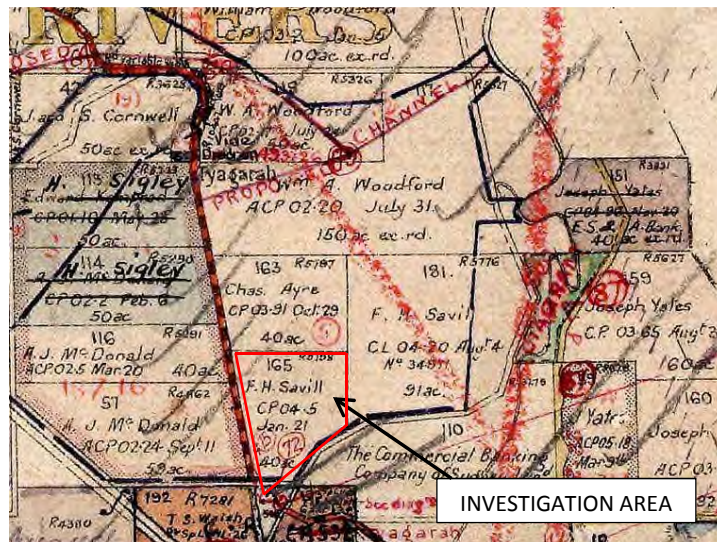


Figure 1. 1912 parish map (NSW LPI Parish Map Preservation Project)



Figure 2. 1938 parish map (NSW LPI Parish Map Preservation Project)

A 1958 (Figure 3) and 1966 (Figure 4) aerial photograph of the subject area shows the land use at that time. The area is generally forested or cleared, and would likely be used for grazing cattle. Vehicle access tracks around the area and vegetation are evident, and it appears that adjacent subject portions were being utilised as the one farm and a common land use. There are no buildings evident within the subject three portion, nor signs of sand mining. There is what appears to be a dwelling adjacent to the highway, however this is outside the subject investigation area.

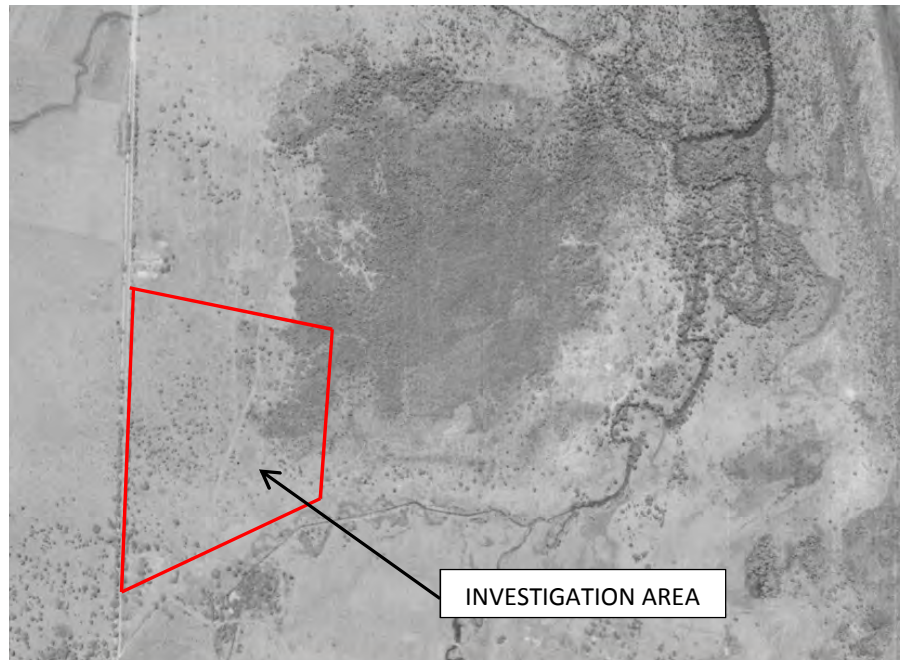


Figure 3. 1958 aerial photograph.

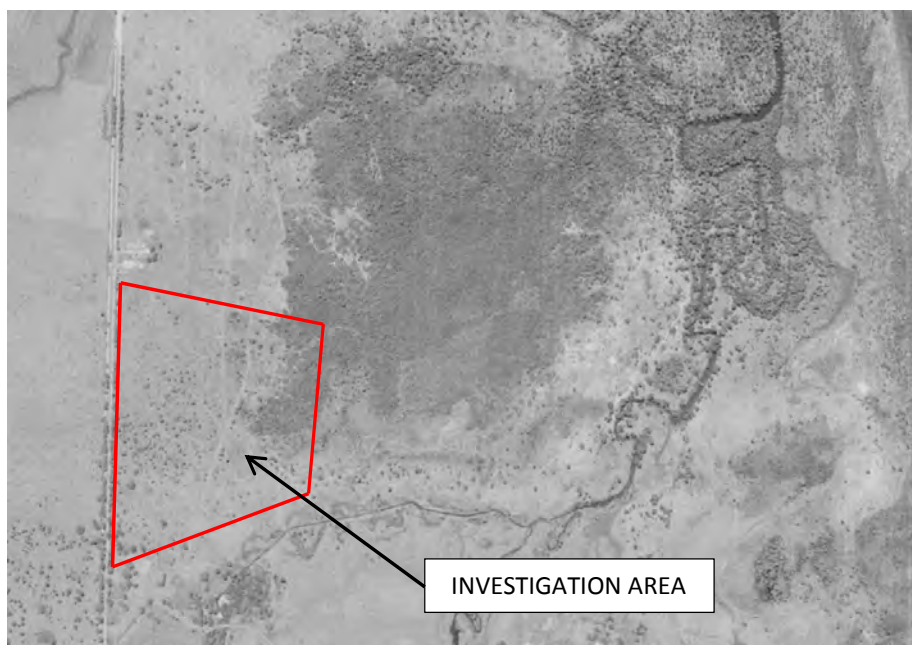


Figure 4. 1966 aerial photograph.

A 1971 aerial photograph (Figure 5) shows that the construction of the existing Tyagarah airstrip had commenced. It is likely that the form of clearing was mechanical based on the disturbance evident in Figure 4. There were no buildings present at the subject allotments at this point in time which leads to lead contamination from paint on existing buildings not being likely. It can also be seen that some

sand quarrying was occurring to the north of the subject area, however no quarrying activities were occurring within the investigation area.



Figure 5. 1971 aerial photograph.

An excerpt from the 1984 CMA Brunswick Heads 9640-4-N Topographic map shows the subject portion 165 and its land uses (Figure 6). The Tyagarah landing ground was established and a hanger was present. A gun club was also established on the subject site, and is still in existence as the Tyagarah Clay Target Club Inc. The remainder of the site appears to have remained as regrowth vegetation. Buildings were present on portion 163, however these are not considered to be a source of contamination to the investigation area.



Figure 6. Excerpt from 1984 Topographic map.

5 SITE CONDITION AND SURROUNDING ENVIRONMENT

5.1 Site Investigation

Staff of this office investigated the subject site, which is accessed from Yarin Lane. The investigation occurred on the 28th January 2015. The investigation area consisted of the areas proposed to be subdivided into Commercial/industrial allotments, but not around the existing buildings or land uses that are not proposed to experience a change in use. A general inspection of the surrounding area and land uses was also made.

5.2 General Site Condition

The investigation area consisted of regrowth paper bark swamp and grassed areas. There had been recent rain leading to the soils being soft and easy to sample.

5.3 Signs of Contamination

The site was investigated in order to determine any physical signs of contamination, such as drums, waste, fill material, odours, old buildings, plant stress or soil staining or bare patches. Due to the age of most buildings (after 1970), the risk of soil contamination from lead based paints is limited, however as the buildings are not proposed to experience a change in use no investigation around them is necessary. Furthermore, lead is a known contaminant at shooting ranges, and the shooting range on the subject site may have lead contamination present, but as the facility is to remain as a shooting range, no investigation into lead is undertaken under this assessment.

Based on the site history, the vacant areas of the investigation area do not appear to have had contaminating activities occurring on them. It is these presently vacant areas that form the proposed lots that will experience a change in use and hence require investigating for the possibility of soil contamination. The aerial imagery sourced for this assessment suggests that these areas were cleared for cattle grazing, and subsequently allowed to revegetate. There were what appeared to be old stockpiles of road base along the southern side of Yarin Lane, and soil testing was done within this soil to determine if any contamination was present.

Tyagarah airstrip may also be a source of contamination. Nunes et. Al. (2011) shows that soil contamination at airports is associated with *'fuel storage, stormwater runoff and drainage systems, fuel hydrant systems, fuel transport and refuelling, atmospheric deposition, rescue and fire fighting training areas, winter operations, electrical substations, storage of chemical products by airport owners or tenants, and maintenance of green areas.'* As Tyagarah airstrip has only been operating from the 1970's, experiences very low volumes of aircraft traffic and only allows smaller propeller planes to use the airstrip, it is considered that contamination of the sites soils from exhaust emissions is unlikely, however soil testing including a heavy metal suite will provide insight into any presence of contamination. There is a fuel storage tank in the investigation area, and as this tank is to remain in use following the proposed subdivision, no investigation for contamination adjacent to it was undertaken.

6 GEOLOGY AND SOIL

Morand (1994) maps the soil of the proposed development area as being within the 'Tyagarah Aeolian' soil landscape. This soil landscape is described as consisting of deep (>150cm) well drained podzols and acid peats near barrier systems. Geology consists of Quaternary estuarine alluvium overlain by and/or mixed with Quaternary (Pleistocene) sands. Sands are generally Aeolian.

If chemicals were used on the site, due to the soil texture and structure, the contaminants would be remaining in the upper layers, typically 0-150mm for arsenic, 0-300mm for lead and 0-75mm for dieldrin.

As stated in Schedule B1 of NEPM 1999 (2013), HIL's are generic to all soil types and so will not require a textural classification for determining investigation Levels. It is understood soil texture is applicable for determining Ecological Investigation Levels (EIL's), Hence soil characteristics for the Tyagarah Soil landscape as recorded by Morand (1994) were used for calculating EIL's.

7 SAMPLING METHODOLOGY

Sample locations were based on sampling areas experiencing a change in sensitivity. Excluding fuel storage and workshops associated with the airstrip, the site history and aerial photography indicated that contaminating activities had not occurred on the subject site across any location. Buildings were constructed post 1970 which leads to lead contamination via paints as very unlikely, and existing building and infrastructure is not proposed to change in use anyway. Composite soil samples 1 & 3 were collected across areas proposed to have industrial/commercial sheds constructed, while composite was taken adjacent to the proposed lots and the land used for the airfield. These three composite samples provide a broad area of assessment, which is useful for detecting if any unknown past agricultural practices have caused contamination to the site.

The soil sampling pattern was systematic as the samples were collected in transects at intervals of 20m in length, forming 60m transects. Twelve point samples were collected across the site, forming three composite samples (four subsamples per composite). In the event of there being high levels of contaminants found in a composite sample, further soil testing will be carried out to pin point contaminant locations and levels by analysing the sub samples forming the composite sample.

Sampling was undertaken in the top soil at the site in order to provide a more conservative assessment (due to if contaminants are present, they would be in the upper soil profile, bound to clay and organic particles). All composite samples consisted of four point sample (A, B, C & D) with the location of each sample point recorded using GPS:

Table 1. Soil sample locations.

Composite sample 1		Composite sample 2		Composite sample 3	
Sample	Location	Sample	Location	Sample	Location
1a	Lat -28°35'38.83"S Long 153°32'43.59"E	2a	Lat -28°35'42.84"S Long 153°32'47.87"E	3a	Lat -28°35'40.01"S Long 153°32'43.38"E
1b	Lat -28°35'38.23"S Long 153°32'43.60"E	2b	Lat -28°35'43.43"S Long 153°32'48.08"E	3b	Lat -28°35'40.28"S Long 153°32'43.87"E
1c	Lat -28°35'37.63"S Long 153°32'43.64"E	2c	Lat -28°35'44.07"S Long 153°32'48.30"E	3c	Lat -28°35'40.85"S Long 153°32'44.98"E
1d	Lat -28°35'37.08"S Long 153°32'43.67"E	2d	Lat -28°35'44.54"S Long 153°32'47.80"E	3d	Lat -28°35'40.98"S Long 153°32'45.52"E

Exhibit No.2 presents the soil sample location.

Samples collected by this office were collected using a hand auger, placed in plastic bags and sealed prior to placing in an esky. All samples were transported by staff of this office to the Richmond Water Laboratories (RWL) the same day of collection. The RWL made the composite samples from the sub-samples provided and subcontracted organochlorines and organophosphorus analysis to Envirolab. The RWL analysed the soil samples for heavy metals. Laboratory QA/QC are attached to this report, with the chain of custody from this office.

8 BASIS FOR ASSESSMENT CRITERIA

Due to the known history of the investigation area the soil sampling suite was specific to possible contamination sources. Sample analysis included heavy metals and chemicals that were commonly used in fertilisers, pesticides and herbicides and that contained heavy metals such as arsenic pentoxide, lead arsenate, organochlorines (DDT, Dieldrin/aldrin) and organophosphates, and heavy metals such as lead and zinc. Sample analysis also included heavy metals and chemicals that are associated with building materials which present the greatest risk to health and the environment. Furthermore heavy metals will indicate possible contamination from long term exposure to fuel from the airstrip.

A conceptual site model has been generated for the site showing potential paths of contamination if present (**Exhibit No. 3**).

Metals can be naturally occurring within a soil profile (Table 2). This office has conducted a number of soil sampling assessments within the Tyagarah Soil Landscape and background concentrations from these assessments present a more accurate range than from generic ranges noted from the literature.

Table 2: Background Ranges for Potential Contaminants

Pollutant	Background Range (mg/kg)
Arsenic	0-5
Lead	0-5
Cadmium	<1
Copper	0-10
Zinc	0-10

NSW EPA (1995) & NEPM 1999 (2013) state that if the contaminant concentration of the site is below a threshold limit, the site can be considered as uncontaminated.

As per Section 3.2.2 of Schedule B1 of NEPM 1999 (2013), if Tier 1 investigations levels are exceeded and it is indicated that there is a risk of negative impact to human or ecological health, a site specific risk assessment will be undertaken. This may involve additional soil sampling or development of a management plan to mitigate potential risks from contamination, and would involve the generation of Groundwater Investigation Levels (GILs) to ensure no contamination to the ground water was or has occurred.

8.1 Health Investigation Levels

The results of the soil sample analysis are compared with the Health Investigation Levels (HILs) set out in Table 1A(1) of NEPM 1999 (2013) under 'Commercial/industrial D'.

Due to the use of a composite sampling technique, the acceptable limit outlined in Table 1A(1) of NEPM 1999 (2013) had to be adjusted by dividing the acceptable limit by the number of subsoil samples per composite, which in this case is four. The adjustable acceptable limit, which is a very conservative approach, was used to determine the presence of hotspots, based on the worst case scenario of presuming one sample has a high concentration while the remaining sub-samples all have zero concentration. If results from the composites taken from the site were above the adjusted acceptable limit, then all subsoils of the failed composite will be analysed individually.

Table 3: NEPM 1999 (2013) HIL Acceptable Levels for Commercial/Industrial D.

Contaminant	NEPM HIL Acceptable Limit (mg/kg)	NEPM HIL Adjusted Acceptable Limit for 4 subsamples (mg/kg)
Arsenic	3000	750
Lead	1500	375
Cadmium	900	225
Copper	240000	60000
Zinc	400000	100000
DDT-DDE-DDD	3600	900
Aldrin/Dieldrin	45	11.25

8.2 Ecological Investigation Levels

Site specific EIL's were calculated for the subject site (Table 4) using the calculator from the NEPM 'toolbox'. The species protection level chosen for this assessment was based on commercial and industrial land use sites, which affords 60% protection of terrestrial species. NEPM 1999 (2013) nominates generic EIL's across all soil types for arsenic, DDT and lead, while copper and zinc EIL's were calculated using soil data from Morand (1994). No EIL has been developed for cadmium within the NEPM EIL calculator. If cadmium is detected above background concentrations within soil samples, further risk assessment will be undertaken.

Table 4. EIL's for the site

Pollutant	EIL (mg/kg)	Adjusted EIL for 4 subsamples (mg/kg)
Arsenic	160	40
Lead	1800	450
Copper	150	37.5
DDT	640	160
Zinc	360	90

9 RESULTS

A site plan is provided in **Exhibit No. 2**, presenting soil test locations. Table 5 presents a summary of the soil analysis results from the composite soil samples collected by this office. The full copies of the analysis results are also attached to this report in Appendix B.

Table 5: Summary of composite soil sample analysis results.

Analyte	Composite sample number		
	1	2	3
OC/OP	<0.1	<0.1	<0.1
Arsenic	<5	<5	<5
Cadmium	<1	<1	<1
Copper	2	<1	3
Lead	4	3	11
Zinc	7	5	15

9.1 Interpretation of Results

The results of the soil analysis are compared with the HILs and EILs derived for this assessment. Organochlorines and organophosphates were not recorded at detectable concentrations, either was the heavy metals cadmium and Arsenic. Copper, zinc and lead were found in varied but low concentrations in all composite samples.

The results of the sampling regime and the known history of the site indicate that further investigation is not warranted in the proposed development location. The contaminants found at the site are in low levels and are below the current HILs & EILs. NSW EPA (1995) state that if the contaminant concentration of the site is below a threshold limit, the investigation area can be considered as uncontaminated.

10 CONCLUSION

A preliminary contaminated soil investigation was undertaken in the proposed development area of Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah, in order to determine if the site has been contaminated from past land use. As part of the assessment under SEPP 55, to ensure that the investigation area has not been contaminated, soil testing was undertaken and the site history was reviewed.

Three soil composite samples were collected over the site at the locations shown on **Exhibit No 2**. Samples were analysed for heavy metals (including arsenic, lead and copper), organochlorines (including DDT and aldrin/Dieldrin) and organophosphorus, which were considered to be the most likely chemicals to cause contamination at the site due to past agricultural use of the site and adjacent areas, and also for the use of the site as an airstrip.

The sampling results were compared with the HILs set out in Table 1A(1) of NEPM 1999 (2013) under Commercial/industrial D, using 'adjusted acceptable levels' and site specific EIL's. All results were below the relevant HILs and EILs. The low to undetectable concentrations of heavy metals and organochlorines/organophosphates respectively indicates that past agricultural practices or the current use as an airstrip has not contaminated the investigation area. All potential contaminants were either undetectable within the soil samples or were in low concentrations.

Based on the known history of the site, inspection of the site and sampling regime, it is concluded that further soil contamination assessment is not required in the proposed development area, and that it is suitable for the proposed subdivision. NSW EPA (1995) and NEPM 1999 (2013) state that if the contaminant concentration of the site is below a threshold limit, the investigation area can be considered as uncontaminated, and this is considered to be the case on this site.

11 REFERENCES

Australian and New Zealand Environment and Conservation Council and National Health and Medical Research Council (1992). *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*.

Department of Urban Affairs and Planning and the Environment Protection Authority (1998). *Managing Land Contamination, Planning Guidelines SEPP 55 – Remediation of Land*.

Morand, D.T. (1994). *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* Report, Soil Conservation Service of NSW, Sydney.

National Environment Protection (Assessment of Site Contamination) Measure 1999 (2013).

NSW EPA (2000). *Guidelines for Consultants Reporting Contaminated Sites*. NSW EPA Sydney South

NSW DEC (2006). *Contaminated Sites – Guidelines for the NSW Site Auditor Scheme*. NSW EPA Sydney South

NSW EPA (1995). *Contaminated Sites – Sampling Design Guidelines*. NSW EPA Chatswood.

Nunes, L. M, Zhu, Y. G., Stigter, T. Y., Monteiro, J. P & Teixeira, M. R. (2011). Environmental impacts on soil and groundwater at airports: origin, contaminants of concern and environmental risks. *Journal of Environmental Monitoring* 13 (11): pages 3026-39.

APPENDICIES

CHAIN OF CUSTODY

CHAIN OF CUSTODY FORM

Sheet 1 of 1

INVESTIGATOR: GREG ALDERSON AND ASSOCIATES PTY. LTD. ABN 60 059 559 858 Scarraheelottie Rd, Nashua 2479 Ph: 02 6629 1552 Fax: 02 6629 1566 E-mail: office@aldersonassociates.com.au Contact: Wendy Atwill		Container		Sample Matrix		Sample Preservation		SITE: 15112		
Sample ID	Date of Collection	Plastic Bag	Plastic Bottle	Glass Bottle	Soil	Soil Composite	Water	Other	COURIER: us LABORATORIES: RVL Contact: Allison Hawthorne Laboratory Analysis Required	
1a-D	28/01/15	✓			✓				Mix to form comp 1	
2A-D	"	✓			✓				Mix to form comp 2	
3A-D	"	✓			✓				Mix to form comp 3	
									} Heavy metals, OFS & OC's	
Investigator: I attest that the proper field sampling procedures were used during the collection of these sample/s. Signed: <i>D. Brooks</i>										Sampler Name (print): Dylan Brooks
Relinquished by: <i>D. Brooks</i>		Date:	28/1/15	Time:	4:15pm	Received by: <i>[Signature]</i>		Date:	28/1/15	
Relinquished by:		Date:		Time:		Received by:		Date:		
Relinquished by:		Date:		Time:		Received by:		Date:		

LABORATORY ANALYSIS RESULTS



Certificate Of Analysis

Client: Greg Alderson & Associates
Address: 133 Scarrabelottis Road
Nashua NSW 2479
Contact: Greg Alderson
Sampled by: Dylan Brooks
Subcontract Laboratory: Envirolab (NATA2901)
Subcontract Reference: 122710

GAA Soil Routine - 15112

Report no: 15/0161
Date sampled: 28/01/2015
Date received: 28/01/2015
Date reported: 6/02/2015
No. of samples: 3
Revision no: 00
Testing commenced: 29/01/2015

Analysis results apply to samples as received.

PARAMETER	Unit	Method	LOR	15/0161-1 15112 - Composite 1	15/0161-2 15112 - Composite 2	15/0161-3 15112 - Composite 3
OC/OP in soil*	mg/kg	Envirolab	0.1	<0.10	<0.10	<0.10
OC/OP QC Recovery	%	Envirolab	0.1	90	88	88
Arsenic - soil	mg/kg	APHA3120B	5	<5	<5	<5
Cadmium - soil	mg/kg	APHA3120B	1	<1	<1	<1
Copper - soil	mg/kg	APHA3120B	1	2	<1	3
Lead - soil	mg/kg	APHA3120B	1	4	3	11
Zinc - soil	mg/kg	APHA3120B	1	7	5	15
Arsenic -QC Recovery	%	APHA3120B	1	96	[NA]	[NA]
Cadmium - QC Recovery	%	APHA3120B	1	100	[NA]	[NA]
Copper - QC recovery	%	APHA3120B	1	100	[NA]	[NA]
Lead - QC recovery	%	APHA3120B	1	98	[NA]	[NA]
Zinc -QC recovery	%	APHA3120B	1	90	[NA]	[NA]

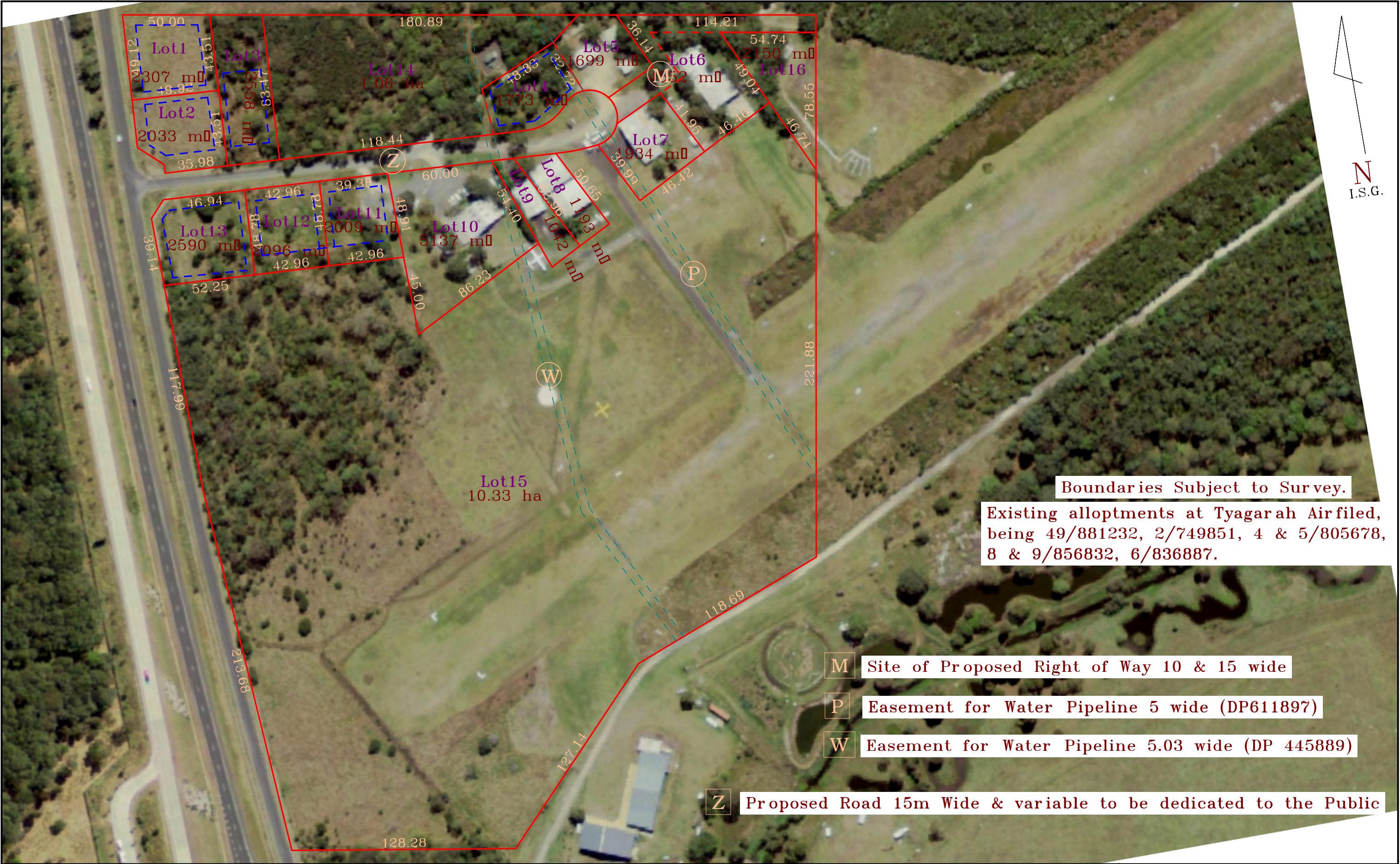
Comments:

A. Hawthorne
Laboratory Manager
Approved Authoriser

This report must not be reproduced except in full.
This report relates only to the items tested as specified herein.
Samples analysed between date received and date reported.

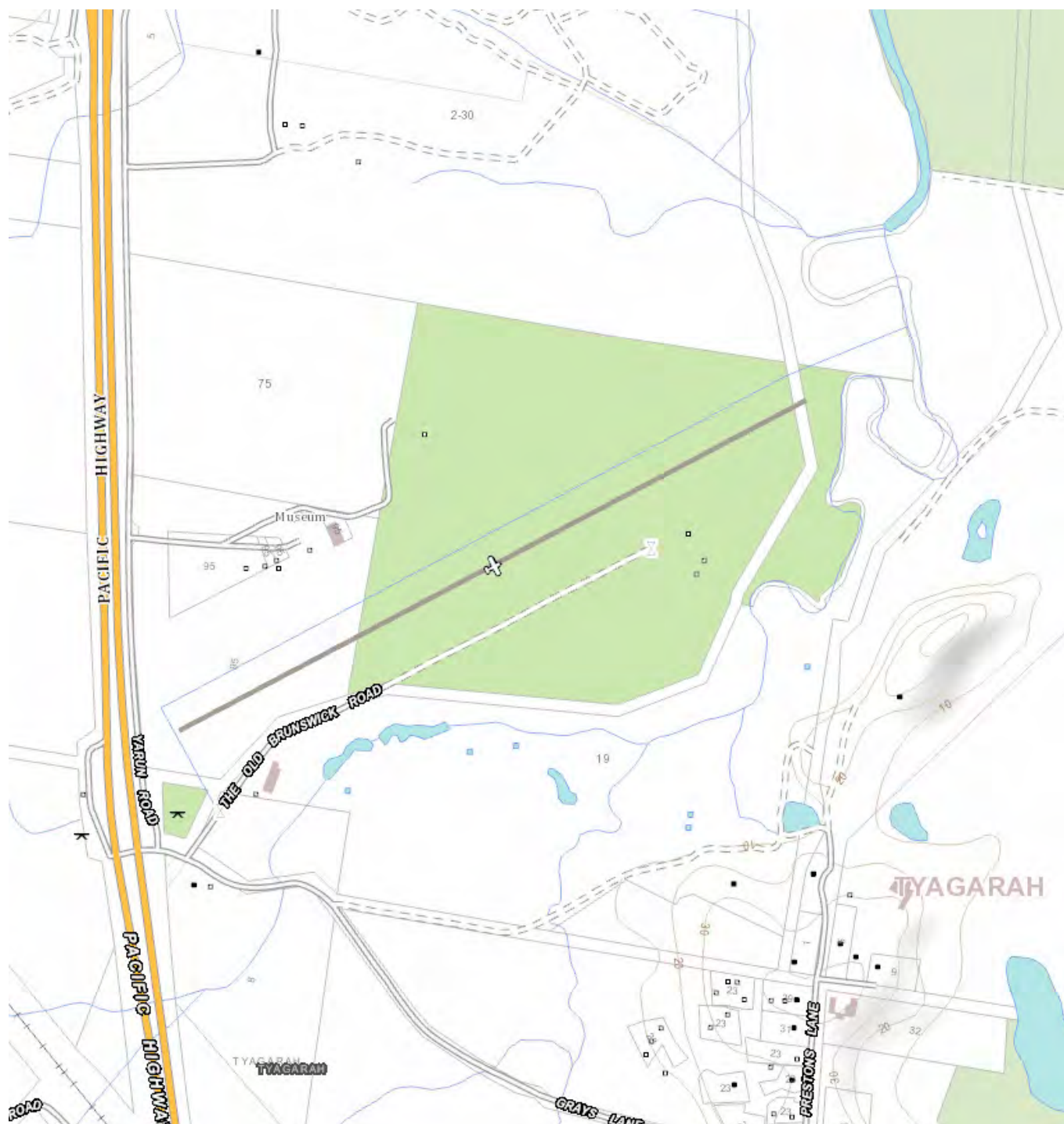
Accredited for compliance with ISO/IEC 17025.
NATA accreditation does not cover the performance of this service.
Tests marked with a '*' are subcontracted.
LOR denotes 'Limit of Reporting'.

APPENDIX A – SUBDIVISION PLAN



Surveyor: Date of Survey: Surveyor's Ref:	PLAN OF Proposed Boundary Adjustments & Subdivision of various allotments at Tyagarah Airfield	LGA: Locality: Subdivision No: Lengths are in metres. Reduction Ratio 1:	Registered	DP
---	--	---	------------	----

	10	20	30	40	50	Table of mm	90	100	110	120	130	140
--	----	----	----	----	----	-------------	----	-----	-----	-----	-----	-----

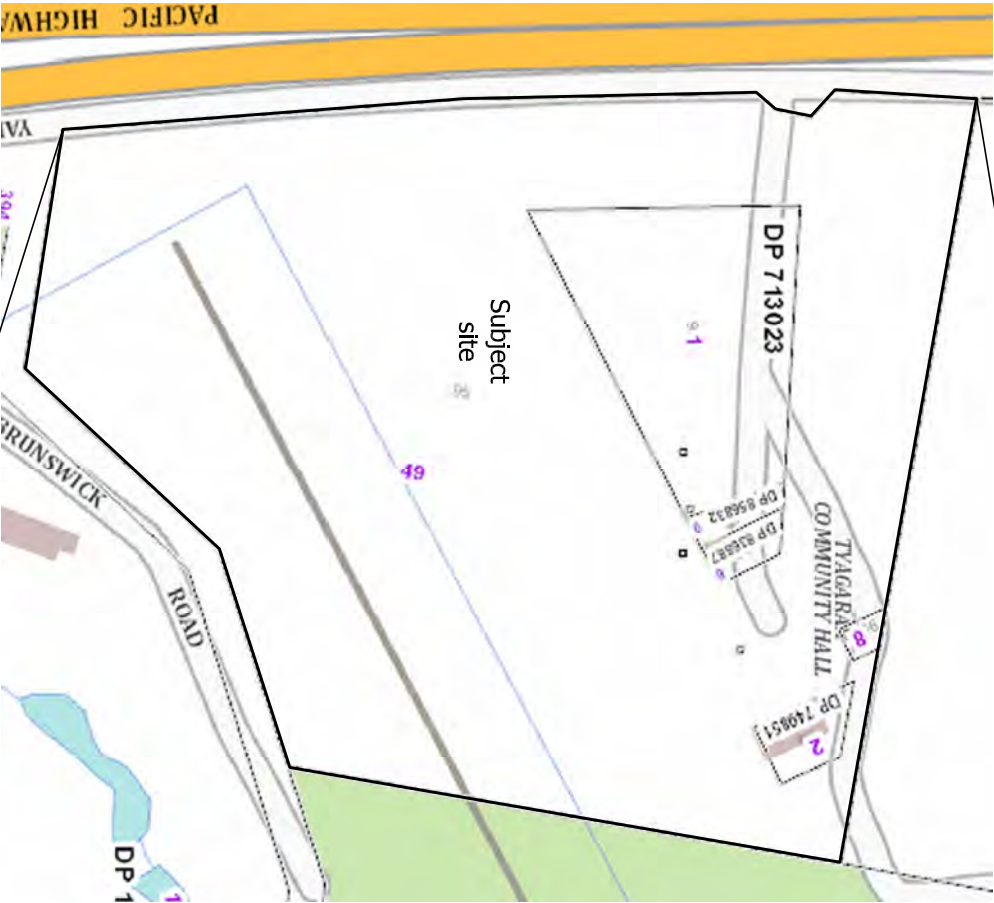


Source: NSW LPI Spatial Information
Exchange (2015)
Date 6/03/2015
Project No. 15112_sepp55
Scale: NTS

GREG ALDERSON AND ASSOCIATES
ABN 58 594 160 789
133 Scarrabelottis Road Nashua NSW 2479
Phone: (02) 6629 1552
Email: office@aldersonassociates.com.au

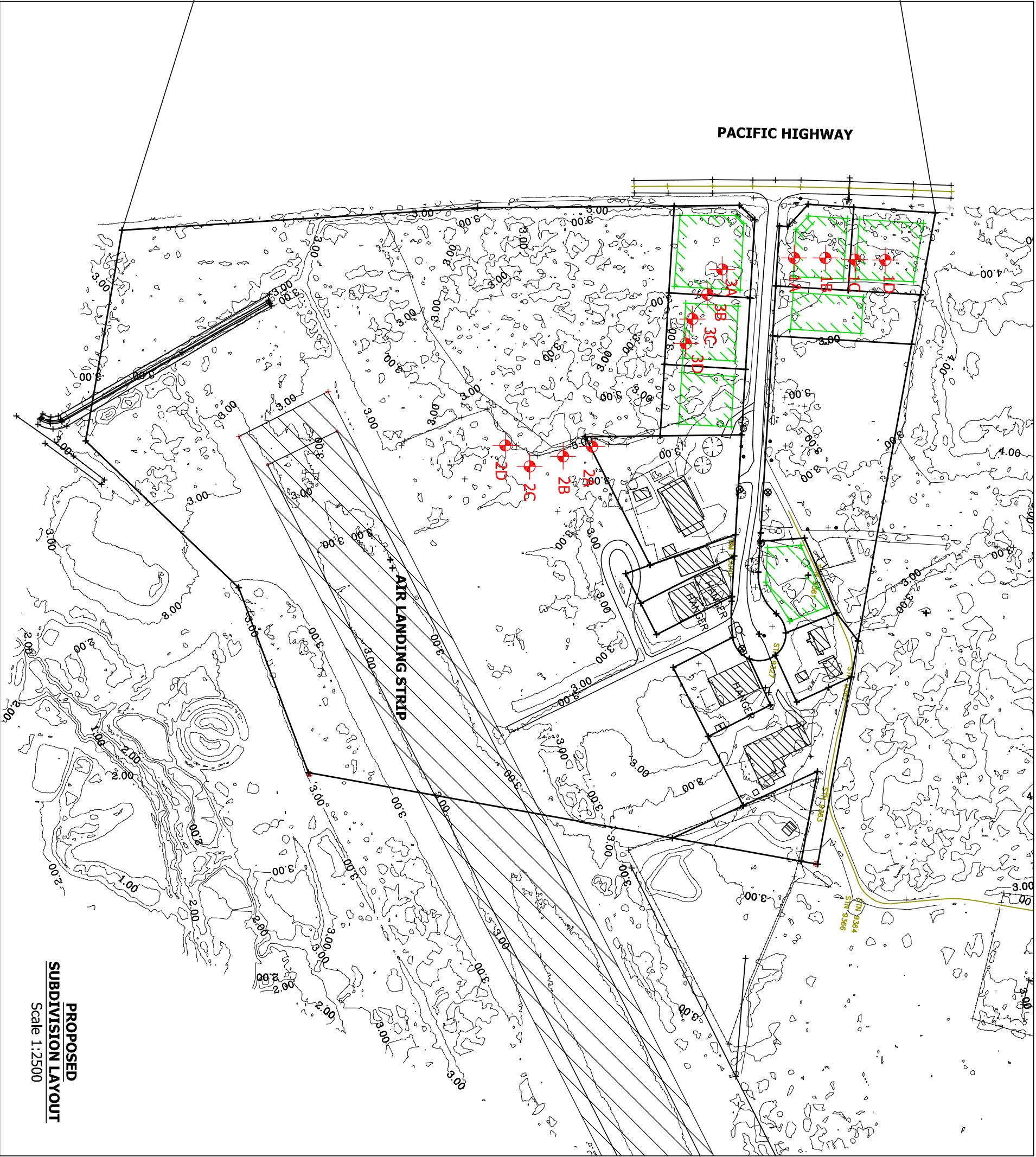
Exhibit No. 1. SITE LOCATION

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP
856832 & Lot 49 DP 881232,
Yarin Lane, Tyagarah

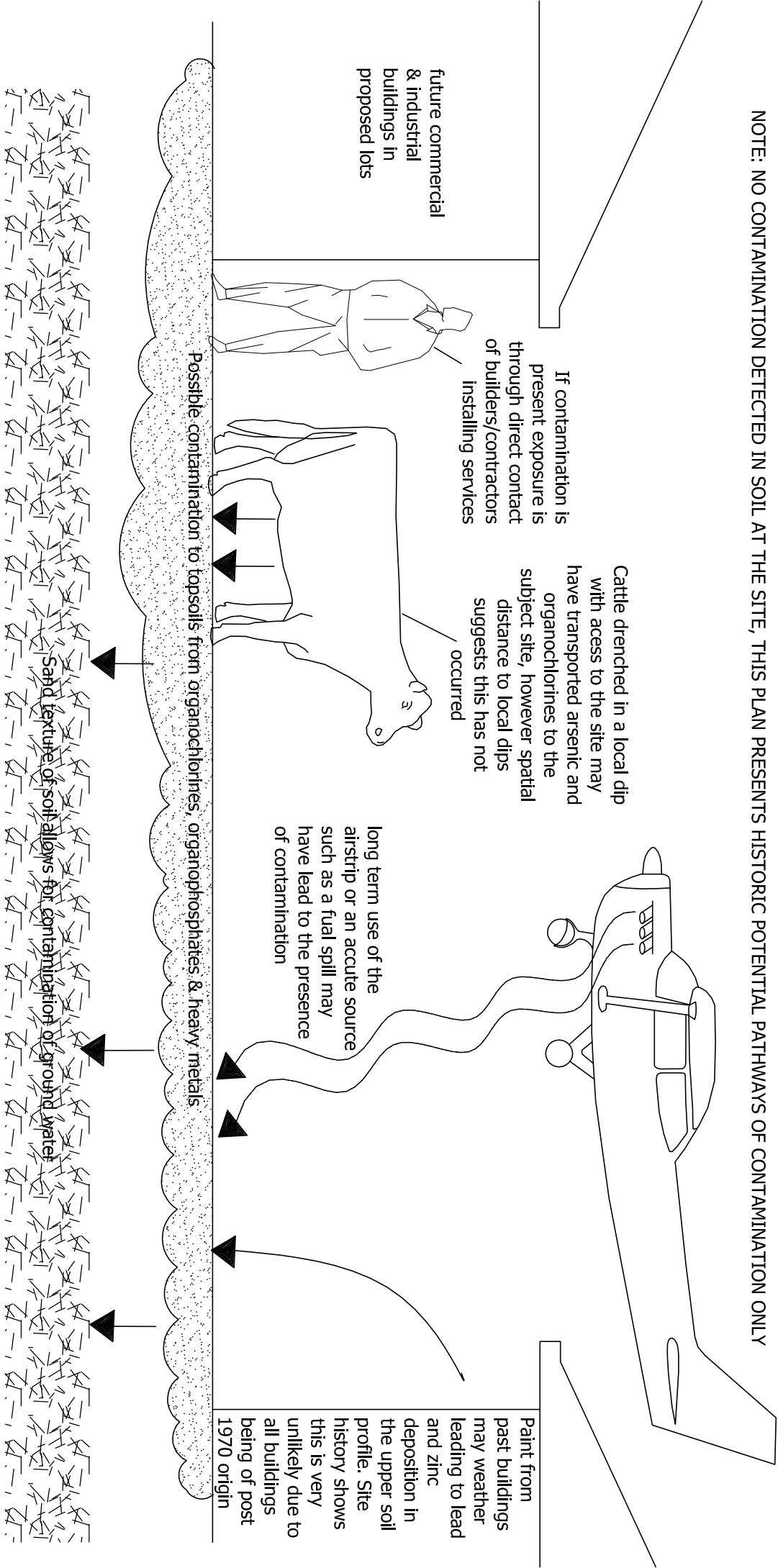


EXISTING LOT LAYOUT
1:3000

- Denotes sample point
- Denotes proposed building envelope
- Denotes existing buildings



NOTE: NO CONTAMINATION DETECTED IN SOIL AT THE SITE, THIS PLAN PRESENTS HISTORIC POTENTIAL PATHWAYS OF CONTAMINATION ONLY



If contamination were present, groundwater is at high risk of contamination

Date: 23/03/2015

Scale: As shown at A3

Job No: 15112_sepp55

Drawn: DJB

Source: Greg Alderson & Associates

GREG ALDERSON & ASSOCIATES

ABN 58 594 160 789

Scarabellottis Rd NASHUA NSW 2479

Ph: 02 6629 1552 Fax: 02 6629 1566

Email: office@aldersonassociates.com.au

**EXHIBIT NO. 3
CONCEPTUAL SITE MODEL**

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots

8 & 9 DP 856832 & Lot 49 DP 881232

Yarin Lane, Tyagarah

APPENDIX C

Section 117 Ministerial Directions Checklist

Section 117 Direction	Applies?	Comments
a) Employment and Resources		
1.1 Business and Industrial Zones	N/A	-
1.2 Rural Zones	Yes	This direction applies where a draft LEP affects land within an existing rural zone. It requires that a planning proposal must not rezone land from a rural zone to a residential, business, industrial, village or tourist zone. This planning proposal does not propose a change of zoning. Further, given the objective of this Direction – to protect the agricultural production value of rural land – it is considered that the proposed LEP amendment is of minor significance given that the historic and continuing use of the land as an airfield results in it having no viable agricultural production value.
1.3 Mining, Petroleum Production and Extractive Industries	N/A	-
1.4 Oyster Aquaculture	N/A	-
1.5 Rural Lands	N/A	This direction applies where a draft LEP affects land within an existing rural or environmental protection zone. It requires that such a draft LEP must be consistent with the planning principles contained in SEPP (Rural Lands) 2008. This SEPP is addressed above. As outlined therein, the intention of those principles is to protect rural or environmental land demonstrated to have value in terms of agricultural or other economic potential, rural lifestyle/amenity value, or natural resource value. In this case, the site is not considered to have agricultural potential given the historic and existing site uses. While parts of the site have high biodiversity values, the development proposal will ensure ongoing retention and protection of those values.
b) Environment and Heritage		
2.1 Environment Protection Zones	Yes	The Direction requires that <i>'a planning proposal must include provisions that facilitate the protection and conservation of environmentally sensitive areas'</i>. In this case, the protection of environmentally sensitive koala habitat on the site will be protected and conserved through its inclusion within a single lot, to be retained in Council's ownership and classified as Community Land.
		The Direction also requires that <i>'a draft LEP that applies to land within an environment protection zone or land otherwise identified for environment protection purposes in a LEP shall not reduce the environmental protection standards that apply to the land'</i>. The assessment outlined in this planning proposal demonstrates that, other than the koala habitat lot, the development is limited to the parts of the site that are highly disturbed. Additional native vegetation planting will be incorporated into the development to offset the minor impacts associated with any minor tree clearing that may be required to implement the development. It is considered that the draft LEP is consistent with this Direction as environmental impacts are of minor significance.

Section 117 Direction	Applies?	Comments
2.2 Coastal Protection	Yes	This Direction is applicable as the land is located within the Coastal Zone. It requires that a draft LEP should be considered in relation to: <u>The NSW Coastal Policy:</u> This Policy addresses a number of key coastal themes including: population growth, coastal water quality issues, acid sulfate soils, ESD considerations and integrated management across levels of government. The rezoning of this land is considered to be consistent with the Policy in that it will result in development that retains and strengthens existing community aviation resources in a manner that avoids and/or minimises biophysical impacts in relation to soils, water and vegetation. <u>Coastal Design Guidelines:</u> The guidelines, in the main, relate to settlement planning and to built-form considerations. Nonetheless, a number of the design principles are relevant, relating to protection of natural edges, connectivity and accessibility of open space, and the like. The proposed development is considered to be consistent with these guidelines as it utilises previously disturbed land to ensure the ongoing viability of aviation services in the Byron Shire. <u>Coastline Management Manual:</u> This Manual is not directly relevant as it primarily relates to the management of coastal process, mainly erosion and accretion, coastal recession and the like. The site is located well away from the active coastal zone and is not at risk from ongoing coastal processes.
2.3 Heritage Conservation	N/A	The site does not contain any know items of Indigenous or European environmental heritage. A comprehensive heritage assessment will be undertaken to accompany a future development application for the development of the land.
2.4 Recreation Vehicle Areas	N/A	-
c) Housing, Infrastructure and Urban Development		
3.1 Residential Zones	N/A	-
3.2 Caravan Parks and Manufactured Home Estates	N/A	-
3.3 Home Occupations	N/A	-
3.4 Integrated Land Use and Transport		-
3.5 Development Near Licensed Aerodromes	N/A	The primary objective of this Direction is '<i>to ensure the effective and safe operation of aerodromes</i>'. This is, in effect, the same primary objective of the planning proposal – to ensure the ongoing viability of operations at the Tyagarah airstrip. The Direction requires that, in preparing a planning proposal, the planning authority must: ▪ <i>consult with the Department of the Commonwealth responsible for aerodromes and the lessee of the aerodrome – in this case,</i> ▪ <i>take into consideration the Obstacle Limitation Surface (OLS) as defined by that Department of the Commonwealth – in this case.</i> This consultation will be undertaken during the Gateway process.

Section 117 Direction	Applies?	Comments
3.6 Shooting Ranges	N/A	This Direction applies in relation to planning proposals that affect land adjacent to or adjoining an existing shooting range. The intention is to maintain appropriate levels of public safety. In this case the proposed development will increase the range of activities undertaken in proximity to the shooting ranges. These ranges have been operating adjacent to the airstrip for a number of decades without incident. Council will continue to work with the operators of the ranges to ensure that all relevant safety procedures are maintained.
d) Hazard and Risk		
4.1 Acid Sulfate Soils	Y	The site is mapped as containing Class 3 Acid Sulfate Soils. Development of the site will involve some civil works that may involve excavation to a depth of 1m or more. Accordingly, a preliminary assessment has been prepared to address the acid sulfate risk (see Appendix H). That report concludes that the acid sulphate soils risk can be appropriately managed at the site.
4.2 Mine Subsidence and Unstable Land	N/A	-
4.3 Flood Prone Land	Y	Pursuant to this Direction, a Planning Proposal must not contain provisions that apply to the flood planning areas which: a) permit development in floodway areas; b) permit development that will result in significant flood impacts to other properties; c) permit a significant increase in the development of that land; d) are likely to result in a substantially increased requirement for government spending on flood mitigation measures, infrastructure or services; or e) permit development to be carried out without development consent except for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways or high hazard areas), roads, or exempt development. A planning proposal may be inconsistent with this direction if it is supported by a floodplain risk management plan prepared in accordance with the Floodplain Development Manual 2005, or if the provisions that are inconsistent are of minor significance. A preliminary flood assessment report is contained at Appendix D. It has been prepared in accordance with the Floodplain Development Manual 2005, thereby providing justification for the inconsistency with this direction. The assessment concludes that the site is within a 'high flood hazard' location, but, due to low velocities (less than 1m/sec), it is not classed as a 'floodway'. It concludes that the proposed infill development is compatible with the flood hazard and that it will not result in significant flood impacts on other properties.
4.4 Planning for Bushfire Protection	Y	The land is bushfire prone. Consultation with NSW Rural Fire Service indicates that, as the planning proposal does not facilitate residential development, a Bushfire Safety Authority, under the <i>Rural Fires Act 1997</i>, will not be required. RFS indicate that a 15m Asset Protection Zone should be provided as part of any new development.

Section 117 Direction	Applies?	Comments
e) Regional Planning		
5.1 Implementation of Regional Strategies	Y	The Direction specifies that planning proposals must be consistent with the relevant regional strategy. This is addressed in the planning proposal above.
5.2 Sydney Drinking Water Catchments	N/A	-
5.3 Farmland of State and Regional Significance on the NSW Far North Coast	Y	The airfield site is noted as 'Committed Urban Zone' on the Farmland Protection Maps, and is therefore not classified as either Regionally or State Significant farmland.
5.4 Commercial and Retail Development along the Pacific Highway, North Coast	N/A	-
5.5 Revoked	N/A	-
5.6 Revoked	N/A	-
5.7 Revoked	N/A	-
5.8 Second Sydney Airport: Badgerys Creek	N/A	-
5.9 North West Rail Link Corridor Strategy	N/A	-
f) Local Plan Making		
6.1 Approval and Referral Requirements	Y	The planning proposal does not propose the inclusion of any concurrence, consultation or referral provisions.
6.2 Reserving Land for Public Purposes	N/A	-
6.3 Site Specific Provisions	Y	<i>A planning proposal that will amend another environmental planning instrument in order to allow a particular development proposal to be carried out must either:</i> a) <i>allow that land use to be carried out in the zone the land is situated on, or</i> b) <i>rezone the site to an existing zone already applying in the environmental planning instrument that allows that land use without imposing any development standards or requirements in addition to those already contained in that zone, or</i> c) <i>allow that land use on the relevant land without imposing any development standards or requirements in addition to those already contained in the principal environmental planning instrument being amended.</i> In this case, the planning proposal is consistent with scenario b) above, as it applies the SP2 zone, which is an existing zone in BLEP 2014. It does not propose any additional development standards.
d) Metropolitan Planning		
7.1 Implementation of the Metropolitan Plan for Sydney 2036	N/A	-

APPENDIX D

Flood Assessment

GREG ALDERSON & ASSOCIATES.

A.B.N. 58 594 160 789

CHARTERED PROFESSIONAL ENGINEERS & SCIENTISTS

OUR REF: 15112_TYAGARAH_FLOODING

21st April 2015

General Manager
Byron Shire Council
PO Box 219
Mullumbimby NSW 2482

RE: FLOOD ASSESSMENT FOR PROPOSED SUBDIVISION DEVELOPMENT AT LOT 1 DP 713023, LOT 2 DP 749851, LOT 6 DP 836887, LOTS 8 & 9 DP 856832 & LOT 49 DP 881232 YARIN LANE, TYAGARAH FOR BYRON SHIRE COUNCIL

Attention: Ian Macintosh

Ian,

Thank you for your brief to examine and prepare a flood assessment for the above mentioned site, in accordance with the Byron LEP 2014, which came into effect on the 21 July 2014.

The property is located on the eastern side of the Pacific Motorway, and east of Tanner Lane. The site drains to the southern end of Simpsons Creek or the South Arm of the Brunswick River.

The area of the site is approximately 10ha, and the site is relatively flat with levels ranging around RL3.0m AHD. The Tyagarah airstrip is located on part of the subject site, to the south, and also has a ground level of around RL3.0m AHD, and some down to 2.7m AHD. Apparently the Airport Road has bitumen levels of 3.1 to 3.2m AHD, as per Council's survey. We understand these levels are based on satellite survey carried out by Council.

It is proposed that the land general adjacent to the Airstrip Road is the land that is expected to be subdivided and would ultimately be developed.

Ground water was observed to be near surface of the land. However this may be due in part to the construction of the airfield runway construction, which appears to have raised the ground levels, and blocked what appears in the old topographic maps to have been a small natural drain.

The proposed development also includes filling for a Waste Water disposal area. This are is likely to be to the north east of the airfield, or in the south western area of the subject site.

Filling for the proposed commercial buildings may also be undertaken in the area of the land proposed for development.

From work we have carried out in this locality, and calibration of flood modelling we know that the Pacific Motorway construction has changed the drainage channel paths in this area and also changed the flood levels and flood characteristics.

It is our understanding that the design flood level in the vicinity of the subject site is 4.57m AHD. This level is based on DMR work on the Tyagarah Bridge, and as advised by Council.

Scarrabelottis Road NASHUA NSW 2479

Telephone. (02) 6629 1552 & Facsimile. (02) 6629 1566, E-Mail, office@aldersonassociates.com.au
MEMBER OF THE CIVIL COLLEGE, NATIONAL REGISTERED CIVIL ENGINEER, RPEQ 4907

Table 1 Proposed finished levels

Commercial Structures	Ground level (m AHD)	Non habitable uses	Fill Level difference in (m)
Northern area adjacent to Airstrip Road	2.7	Yes, Commercial	1.87
Wastewater disposal area south western area	2.7		1.87

*split level

FLOOD IMPACT ASSESSMENT

DCP 2014 Chapter C2 – Areas Affected by Flood

Section C2.3 documents a three step process to ascertain the flood planning controls to development on land at or below the future flood planning level:

Step 1: Consider the applicable Flood Study for the catchment in which the land is situated, in relation to flood hazard and floor level requirements (Section 2.3.1);

Step 2: Consider the specific Flood Planning provisions for the type of development and flood hazard as set out in the flood planning matrix (Table C2.1); and

Step 3: Consider any special requirements or standard designs for particular localities (Section C2.3.5).

STEP 1 - ESTABLISHMENT OF FLOOD HAZARD AND FLOOR LEVEL REQUIREMENTS

South Arm, or Simpsons Creek Flood Study

Byron Shire Council is in the process of carrying out a flood study that would give a flood level in this are, but this study is not yet completed.

The only available flood level is a level determined by the DMR in 1978, for construction of the Pacific Highway railway bridge. This level was 4.57m AHD.

Work we have carried out on a site approximately 1km to the north set a flood planning level based on anecdotal evidence from the 2005, 1989 and 1987 floods of 3.75m AHD. Tuflow flood modelling done at this site determined the PMF flood level to be RL 4.0m AHD.

The difference in level between the subject land in Airport Road, and the land approximately 1km to the north does seem reasonable, and was calibrated to be within an acceptable model range.

For the purposes of this assessment a Design Flood Level of 4.57m AHD is adopted.

The proposed development from a flood viewpoint, is considered to be in part “infill” development. The proposal does not fit the ‘large scale development’ definition, or “*new release areas*” but rather best fits the definition of ‘Non Habitable Building’ development, which will be within a commercial zones once the rezoning is carried out.

With this definition the development would be allowed, see Table C2.1.

The location of the subject land would place it in the “High Hazard” flood zone, because of the depth of water during a flood. Water would be slow moving but the depth of flood water as per the Floodplain Development Manual Figure G2 nominates a High Hazard determination.

The land then is considered to be “SF1” as per Table C2.1 and as such has “no minimum fill levels”.

Table C2.1 classifies this type of development as SS2, which requires that any building have a structural engineers certificate as to its soundness during a flood.

It will also require an engineers certificate to prove that the building does not impede flood waters or cause an impact elsewhere.

The development under consideration is non habitable infill development and from the information provided by Council, a flood planning level of 4.57m AHD is confirmed appropriate for this development.

STEP 2 – FLOOD PLANNING PROVISIONS MATRIX

Table C2.1 – Flood Planning Matrix documents is the applicable controls and constraints for a particular development / building type. For this proposal the development, being subdivision to create allotments that will be developed as “non habitable infill development”, and with a flood water depth of 1.87m non habitable developments, commercial, could be constructed with special provisions.

- Flood proofing will be required,
- Flood free storage will be required,
- Demonstration that minimal damage would result from a flood passing through the structure,
- The land could be filled to the projected 2050 flood level, as per C2.3.2 of Council’s DCP 2014. At the site to the north the difference between the 1% flood level and the 5% flood level was 400mm. Using this figure the fill level for the projected 2050 flood level would be 4.17m AHD.
- Thus by Council’s DCP filling under buildings and in the wastewater area could be placed to a level of 4.17m AHD.

STEP 3: CONSIDER SPECIAL PROVISIONS (SECTION C2.3.5)

There are no special provisions within Section C2.3.5 of the DCP 2014 that are relevant to the subject locality.

In this site there is some flood information which can be used when buildings are being designed. The flood levels of 4.57m AHD and a flood velocity of less than 1m/s would be suitable to use at this site.

When the building development is proposed on the land, because it is considered **flood liable land**, the applicant will be required to submit a report using local flood information, as described in this assessment or any new information that is available and authorised by Council, to establish the final levels on the site filling equivalent to the **Projected 2050 Flood Planning Level** in relation to the commercial project. This information will need to be supported by a certificate from a professional Civil / Hydraulic Engineer (with qualifications suitable for admission as a corporate Member of Engineers Australia).

CLAUSE 6.3 AND 6.4 OF THE BYRON LEP 2014

The flood impact of the proposed development is assessed in terms of the *NSW Floodplain Development Manual, 2001* (FDM) and Clause 6.3 and 6.4 of the *Byron Local Environmental Plan*

2014 which applies to land at or below the flood planning level. A preliminary Flood assessment is as follows.

[Clause 6.3] *Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:*

(a) is compatible with the flood hazard of the land

As described above, the proposed development is within a “high flood hazard” location, but is slow moving flood water, less than 1m/s velocity.

As the development is proposed to be commercial with “non habitable” rooms, the structures can be in such a way, with minimal extra cost, that they would be considered flood compatible.

According to Table C2.1 the primary and additional constraints to the land use indicate that for non-habitable rooms in the high hazard zone the land ‘*may be considered for development subject to the findings of the remainder of the controls*’ and ‘*No minimum fill required*’.

There are no other controls within the table that would preclude this development proposal.

(b) will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties

The development is essentially infill development as there is already existing commercial development immediately adjacent to the proposed development. The floor levels of the existing development vary but appear to be similar to the ground level, for example aeroplane hanger, with floor levels of around 3.0m AHD.

The existing buildings would be classified as having floor levels that are below the 1:1year flood level, based on the flood differences at the calibrated modelled site to the north. The proposed development will have a better flood suitability than

The proposed developments will have to the following specifications:

- A lower ground floor level of 4.17m AHD (slab on ground) with a general ground profile that is not proposed to be significantly altered and only filling under the structure is proposed.
- Minimal footprint on the ground floor. Stormwater detention is required in tanks above the ground due to the shallow ground water table.
- Rainwater storage tanks are also proposed as a flood and stormwater requirement. These tanks will cause very minor displacement of flood water. However, the remainder of the ground floor structure, including the car parking, is to remain at the ground level of around 3.0m AHD.

Therefore it is anticipated the development would not exacerbate flood behaviour or impact on adjoining properties.

(c) incorporates appropriate measures to manage risk to life from flood

The surface area of the site is relatively flat with levels ranging between 2.7m AHD and 3.2m AHD, according to Council’s survey provided to this office.

The estimated 1% AEP Flood Level is estimated to be 4.57m AHD, as supplied by BSC.

The flood risk for this land has been identified as ranging between up to 'High Hazard', primarily related to flood depth. From inspection and from modelling nearby to this site the flood water velocities are estimated to be in the order of 0.5m/s but confidently below 1m/s.

Tanner Lane and the Pacific Motorway are situated to the west of the subject site. While Tanner Lane is at a lower level the Pacific Motorway is above flood level. It is considered reasonable that a *"truck could evacuate people and their possessions; able bodied adults would have little difficulty wading to safety"*, to the west towards the Pacific Motorway, prior to the full effects of elevated flood waters impacting the site.

If evacuation was not achieved prior to the event, the buildings will have flood free storage areas and would therefore provide refuge for persons until such time as flood waters recede to a depth where access can be gained by a truck or by wading. Therefore it is considered the proposal for the site does not pose any risk to life from flood.

(d) will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses

The site is 'flood storage' and would likely be paved, grassed and landscaped to protect the ground surface from erosion. It is not expected that a velocity of about 0.5m/s would result in erosion of the site. Notwithstanding, all ground covers and landscaping materials will need to be relatively unaffected by submersion. Bark chip mulch is not favoured.

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding

There are no known or unexpected social or economic costs to the community that could occur as a consequence of the site being flooded.

[Clause 6.4] *In determining a development application for development at or below the future flood planning level, the consent authority must, in addition to the matters referred to in subclause (3), also consider the following matters:*

(a) the proximity of the development to the current flood planning area

The proposed development is located within the South Arm of the Brunswick River catchment, which is currently being studied by Council.

(b) the intended design life and scale of the development

The buildings, being commercial in nature are likely to be of corrosion protected steel, concrete, masonry and timber construction. It is anticipated with correct material specification and corrosion protection for the coastal location the building would have a typical design life in the order of 50 years.

The building would need to be consistent with the allowable LEP 2014 planning provisions. The proposed subdivision development, while not designing the building can nominate design requirements.

(c) the sensitivity of the development in relation to managing the risk to life from any flood

The site is not considered especially sensitive with respect to the potential risk to life from the flood scenarios considered. Refer to Item 6.3(c) and 6.4 (a) above for further detail.

(d) the potential to modify, relocate or remove the development

The building designs at ground floor level could have controls that allow for modification to account for varied flood conditions that may be experienced in the future.

OTHER

Structural Soundness

Council will require flood proofing by raising flood free storage and office floors to 0.5m above the Design flood. The Flood Planning Level in this area is 4.57m AHD.

The requirement for future structures is that *any building or structure can withstand the force of flowing floodwaters, including debris and buoyancy forces as appropriate.*

As the floodwaters are generally slow moving (approx. 0.5m/s), the architectural design of future buildings is considered able to withstand these impacts from floating debris, which is likely to only be small branches and limbs of small trees and shrubs and cut grass, without adversely affecting the building cost or appearance.

Notwithstanding the above, engineering certification for the proposed buildings and foundations of the structure should be submitted at the construction certificate stage would need to include the effects of flooded ground. It is expected that this would be required through a consent condition. The structural engineer would need to note this requirement and design accordingly.

The following construction methods should be designed into the ground floor areas of the structures:

- All electrical mains power supply equipment, internal meters, wiring, switches and power points shall be located above 4.57m AHD. No electrical equipment shall be located below 4.57m AHD.
- All ground covers and landscaping materials will need to be relatively unaffected by submersion. Bark chips mulch is not favoured.

Flood Proofing

Flood proofing of buildings takes two forms:

1. Preventing floodwaters from entering the building, and
2. Minimising the impact of floodwaters if the floodwaters do enter the building

The provision is taken of a minimum flood free storage floor level of 4.57m AHD, which is at the design flood level.

It is expected that the floodwater will flow into the space under the suspended floor of future buildings. All remaining ground area would need to be graded in order to direct stormwater flows away from the building without causing additional ponding on neighbouring properties.

Evacuation

As is indicated in Figure 1, the subject site is located near the Pacific Motorway, which is above the 1% AEP flood event. Flood waters between the subject site and higher areas of Pacific Motorway is approximately 100 metres. The depth of flood water is typically 1.57m at the proposed subdivision sites. At an approximate velocity of 0.5m/s and a depth of 1.57m the velocity/depth product ($v \times d$) = 0.3.

If evacuation is necessary, walking or wading through the floodwaters would be possible during the early stages of a regional flood event only, since at the peak of the 1% AEP flood event on-site flood depths would generally be 1.57m. Evacuation would thus have to be performed prior to potential peak of the flooding.

The Byron SES wardens would advise staff at the commercial premises of the possibility of evacuation being required, and the Plan indicates that if evacuation is necessary then SES members would assist persons as required to the evacuation centre. The Plan indicates that SES Headquarters Staff will be continuously monitoring flood levels and, in the event of a flood, will issue flood warnings to all media. Typical flood warning times in Byron Shire are 24 hours.

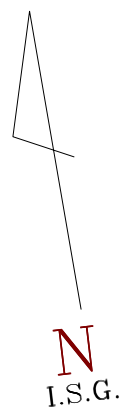
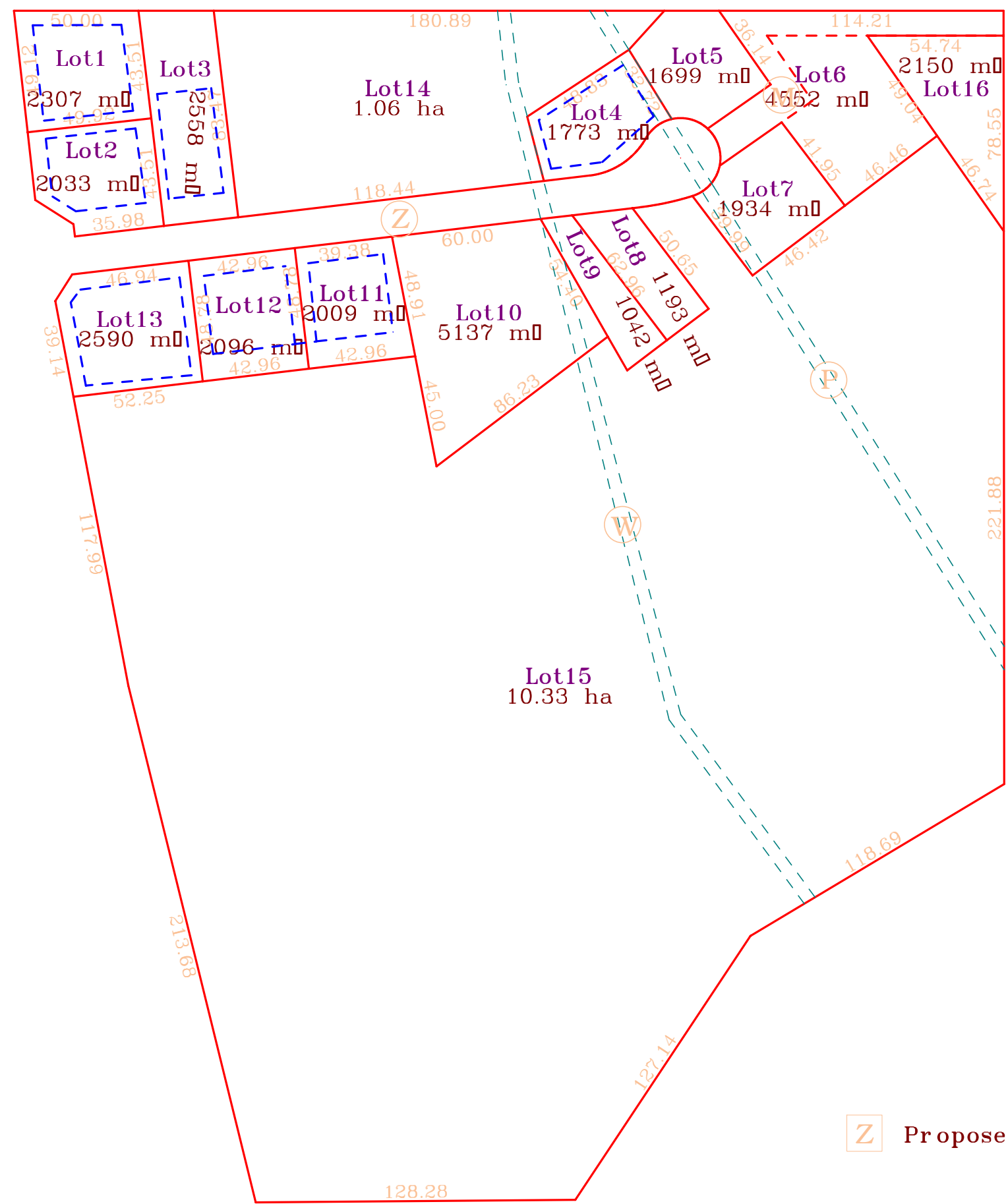
If you have any questions, please contact our office.

Yours faithfully,
Greg Alderson and Associates



Greg Alderson
Chartered Professional Engineer

Attachment: proposed subdivision layout 13/02/2015.



Boundaries Subject to Survey.
Existing alloptments at Tyagarah Airfiled,
being 49/881232, 2/749851, 4 & 5/805678,
8 & 9/856832, 6/836887.

- M** Site of Proposed Right of Way 10 & 15 wide
- P** Easement for Water Pipeline 5 wide (DP611897)
- W** Easement for Water Pipeline 5.03 wide (DP 445889)
- Z** Proposed Road 15m Wide & variable to be dedicated to the Public

Surveyor: Date of Survey: Surveyor's Ref:	PLAN OF Proposed Boundary Adjustments & Subdivision of various allotments at Tyagarah Airfield	LGA: Locality: Subdivision No: Lengths are in metres. Reduction Ratio 1:	Registered	DP
---	--	---	------------	----

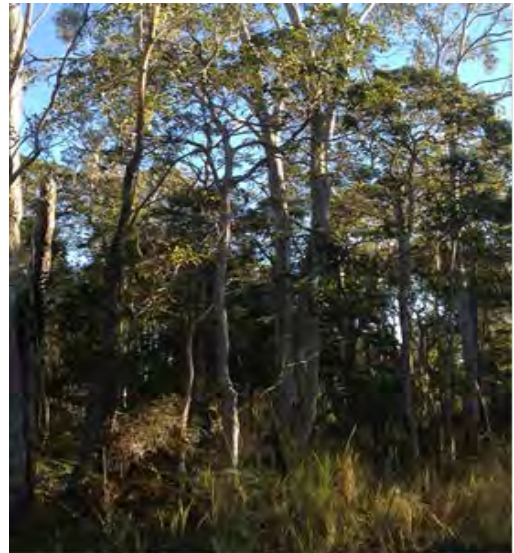
	10	20	30	40	50	Table of mm	90	100	110	120	130	140
--	----	----	----	----	----	-------------	----	-----	-----	-----	-----	-----

APPENDIX E

Flora and Fauna Assessment

DRAFT FLORA AND FAUNA ASSESSMENT

Tyagarah Airport Land
Proposed 14-lot subdivision



Lot 49 DP881232
95 Yarun Road, Tyagarah

Byron Shire Council

August 2014

PREFACE

This report has been prepared to identify the flora and fauna characteristics of the subject site. It provides information regarding existing habitats and the potential for the proposed development to impact on existing species and their habitats.

AUTHOR

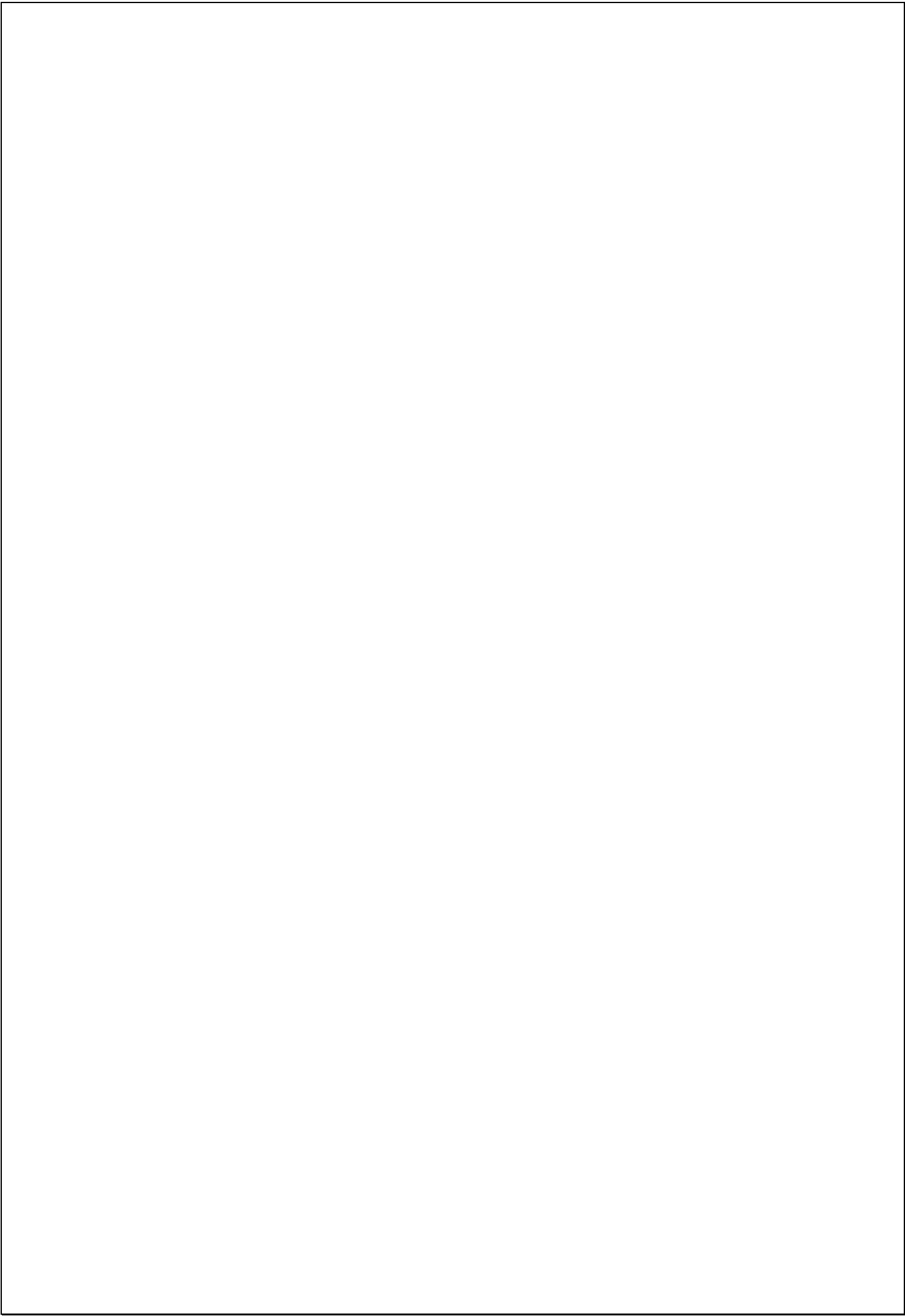
SANDRA LOUISE PIMM B.App.Sc. (Distinction), MEIANZ, Dip.Hort., Cert IV Natural Area Restoration
NPWS Scientific Licence Number: S12045

FIELD ASSISTANCE

Jo Green & Angus Underwood

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	1
SECTION 1: BACKGROUND INFORMATION	3
1.1 INTRODUCTION.....	3
1.2 SITE CHARACTERISTICS	4
1.3 PROPOSED DEVELOPMENT.....	7
SECTION 2: FLORA.....	8
2.1 VEGETATION SURVEY METHODOLOGY.....	8
2.2 VEGETATION COMMUNITY DESCRIPTIONS	10
2.3 THREATENED FLORA SPECIES	18
2.4 ENDANGERED FLORA POPULATIONS AND EEC'S.....	24
SECTION 3: FAUNA.....	26
3.1 FAUNA SURVEY METHODOLOGY	26
3.2 FAUNA HABITATS.....	28
3.3 THREATENED FAUNA SPECIES	31
3.3 ENDANGERED FAUNA POPULATIONS.....	35
SECTION 4: IMPACT ASSESSMENT	36
4.1 POTENTIAL IMPACT ON VEGETATION AND FAUNA HABITATS	36
4.2 REVISED DEVELOPMENT FOOTPRINT	36
4.3 IMPACTS ON THREATENED SPECIES	38
Flora and Vegetation Communities	38
Fauna	39
IMPACT SUMMARY.....	40
ASSESSMENTS OF SIGNIFICANCE (TSC Act 1995)	41
ASSESSMENTS UNDER EPBC ACT 1999.....	45
SECTION 5: LEGISLATIVE PROVISIONS.....	47
SECTION 5: MITIGATION MEASURES	52
SECTION 6: CONCLUSION	54
REFERENCES.....	55
FIGURES	58
Figure 1: Site location	59
Figure 2: Location of 7 existing lots shaded light green.....	60
Figure 3: Proposed subdivision and boundary adjustments for 14 lots.....	61
Figure 4: HCVmapping of site and surrounds (BSC).....	62
Figure 5: Byron GIS mapping of site vegetation and surrounds (BSC)	63
Figure 6: Byron vegetation association mapping (BSC)	64
Figure 7: NPWS Wildlife Corridor mapping of site and surrounds (BSC)	65
Figure 8: Koala mapping of site and surrounds (BSC)	66
Figure 8: Survey Effort	67
Figure 9: Detailed vegetation mapping of site and surrounds (BSC)	68
Figure 11: Accepted revised Lot layout and building envelopes	70
Figure 13: Expected loss of Swamp Sclerophyll EEC and potential offset sites	72
PLATES	73
APPENDIX 1: Flora Species list	77
APPENDIX 2: Fauna Species list.....	83
APPENDIX 4: Wildlife Atlas, EPBC Search results	88



EXECUTIVE SUMMARY

An ecological assessment has been undertaken for a proposed fourteen-lot subdivision by Byron Shire Council at 95 Yarun Road, Tyagarah NSW (Figure 1). The development is expected to attract light industrial and commercial activities associated with the Tyagarah light aircraft Airport. The parcel is owned by Byron Shire Council and classified as operational land under the Local Government Act. The existing lot layout is illustrated in Figure 2 and the proposed subdivision and boundary adjustments are shown in Figure 3.

Desktop and survey results indicate:

- The site contains High Conservation Value (HCV) vegetation and two Endangered Ecological Communities listed under the NSW *Threatened Species Conservation Act 1995*; being *Swamp Sclerophyll Forest on coastal floodplains of the NSW north coast*, and *Sub-tropical Coastal Floodplain Forest*.
- The site contains numerous preferred koala food trees (Swamp Mahogany and Forest Red Gum) and lies within a Koala Management Precinct mapped in the draft Byron Coast Comprehensive Koala Plan of Management. SAT survey on-site indicated koala activity in the 'medium' category for the SW site and the 'high' category for the NE.
- Three threatened fauna species were recorded on the site (Koala, Wallum Froglet, White-eared Monarch). Two more threatened species (Common Planigale and Eastern grass owl) could occur and impacts have been assessed. A number of other threatened species are likely to use the site but to lack essential roost habitat.

Development for subdivision purposes will require the following works:

- Survey, subdivision, boundary adjustments and registration to create 14 lots where 7 currently exist.
- Provision of services to each lot including:
 - Road widening to form a road reserve 15m wide with a cul-de-sac turn around head; minor earthworks; pavement widening; resurfacing and signage. Current road width approximates 5m (paved surface) and 10m (between fences).
 - Piping of reticulated water within the road reserve to each lot from the existing water supply pipeline running through the site.
 - Provision of electricity and telecommunications infrastructure to each lot via an above-ground power line running along the current paved access road.
 - Stormwater management through dedicated infiltration zones or piping.
- This stage of the proposed development services will require to require minor habitat removal.

Important legislative provisions include:

- The site is considered to meet the criteria for 'potential' and 'core' Koala habitat under SEPP 44; therefore a Koala Plan of Management is required to manage the local population and remaining habitat. In this case, the draft Byron Coast Koala Plan of Management is suitable and provisions of that plan have been addressed within this report. Loss of 620m² of Secondary B koala habitat is expected.

Mitigation and amelioration measures undertaken/ to be undertaken are:

- Re-design of the original subdivision layout to reduce lot numbers, avoid High Conservation Value habitat and maintain connectivity with surrounding habitat.
- Site survey and pegging in conjunction with Council's Ecologist to define and avoid (wherever possible) individual ecological constraints
- Stadia survey and protection on title of remnant trees with a diameter at breast height of 250mm or greater and any hollow-bearing trees.
- Allocation of building envelopes on all new allotments.
- Restriction on use of airstrip to diurnal use only (as currently occurs).
- Restriction on use of the land to prevent dogs residing on site.
- Careful consideration of road earthworks and placement of services in the road corridor.
- Allocation of resources to consider alternate Council/Crown land available for pistol, rifle and clay target shooters' clubs to an area of lower ecological sensitivity and negotiation the Committee of the local Pistol and Rifle Club and with the Tyagarah Clay Target Shooters Club to relocate to a site of lower ecological sensitivity.
- Offset site(s) to be secured and site specific Koala Habitat Restoration Plan to be prepared to provide a minimum of 0.55ha of replanting.
- Provision of offset planting and/or rehabilitation (as appropriate to the final offset site(s)) at a ratio of (at least) 10 to 1 (6200m²) to replace lost habitat.

In conclusion:

The subdivision layout has been significantly modified from the original proposal in order to retain important habitat. The revised lot layout retains all areas of highest conservation significance in Council ownership. Given the re-design, it is considered the reduced development footprint will impact primarily cleared land and regrowth vegetation of lower conservation significance. Given these changes:

- A significant impact on threatened species, populations and ecological communities is considered unlikely and a Species Impact Statement is not required.
- Referral under the EPBC Act is not required.
- Additional management plans will be required for the development to proceed to occupation; including bushfire hazard assessment, on-site sewerage, stormwater and hydrology, erosion and sediment control, acid sulphate soil management and flood and bushfire risk.
- Offsets are required for loss of habitat. It is proposed that regeneration works be undertaken within land remaining in Council ownership and that offset sites be negotiated with the Crown and/or RMS to enable replanting of the required 0.55ha of compensatory habitat.

SECTION 1: BACKGROUND INFORMATION

1.1 INTRODUCTION

This report has been prepared to identify the flora and fauna characteristics of Lot 49 DP 881232 (and additional lots described in Table 1.1) at 95 Yarun Road, Tyagarah NSW (Figure 1). It addresses the conservation value and ecological impacts relating to a proposed fourteen-lot subdivision.

The property is located adjacent to the currently operating Tyagarah Airport and is accessed via a Pacific Highway off-ramp onto Yarun Road. An internal road into the light aircraft airport facility is unnamed and not contained within a road reserve. The development is expected to attract light industrial and commercial activities associated with the Tyagarah light aircraft Airport. The parcel is owned by Byron Shire Council and classified as operational land under the Local Government Act (Figure 2). The proposed subdivision is illustrated in Figure 3.

The western boundary of the property adjoins Yarun Road adjacent the Pacific Highway; the northern boundary adjoins land owned by Roads and Maritime Services (previously used as a depot/stockpile site); to the east is a parcel of Crown land under Council control (including part of the airstrip) and to the south the lot includes the remainder of the airstrip and meets a vegetated crown reserve.

Surrounding land uses include commercial and recreational airport uses such as a light aircraft club, parachuting, gliding and hot air ballooning. Beyond these uses are the East Coast Blues and Roots festival site, cleared grazing land and Tyagarah Nature Reserve (approximately 1 kilometre to the east). The combined lots in context with surrounding lots are illustrated in Figure 1.

A flora survey and fauna survey and habitat assessment was undertaken to determine habitat availability for various flora and fauna species and communities with potential to occur on site (Figure 8). In accordance with the DECCW *Threatened Biodiversity Survey and Assessment Guidelines*, where suitable habitat was present for species not surveyed, species presence has been assumed and assessments have been undertaken on that basis. Species of particular interest which were considered during assessment were the Koala and Wallum Froglet, but habitat availability for other locally occurring flora and fauna species has been considered.

1.2 SITE CHARACTERISTICS

The planning and cadastral details of the subject site are provided in Table 1.1 while Table 1.2 summarises the geographical characteristics of the site.

TABLE 1.1 SITE DETAILS	
Location	Lots 49//881232; 5//805678; 4//8056789//856832; 6//836887; 8//856832 and 2//749851 - 95 Yarun Road, Tyagarah NSW
Area	Total area: 15.08ha Respectively per lot: 13.2 ha; 1.01ha; 0.51ha; 0.08ha; 0.09ha; 0.04ha; 0.15ha.
LEP zoning	2014 – RU2 Rural living. and Deferred Matter which reverts to 1(a) Rural (hatched) under LEP 1988
AMG Reference	153°, 32', 35"S; -28°, 35', 40"E
Local Government Area	Byron Shire
Existing Land Use	Existing airport business, gem and rifle clubs, residence and undeveloped bushland
Proposed Development	Fourteen-lot subdivision and boundary adjustments to enable sale of new allotments

TABLE 1.2 SITE CHARACTERISTICS	
Topography	Gently undulating to flat
Slope	0 to 5°
Elevation	< 10m AHD
Geology	Aeolian origin
Soil Type	Beach sands – Tyagarah soil landscape
Catchment	Brunswick River
Drainage	Overland flow to Tyagarah Creek and then to Brunswick River
Vegetation	Open forest (Swamp Sclerophyll), Very tall closed heathland; Closed grassland

Byron Council maps the site as follows (GIS E-view):

TABLE 1.3 MAPPED CHARACTERISTICS			
FEATURE	Present on parcels	Absent from parcels	Comments
High Conservation Value	X		Mapped over more than half of property
Mapped Vegetation	X		Swamp Mahogany/Swamp Box swamp sclerophyll forest in north; Paperbark Swamp Sclerophyll in south-west
Wildlife Corridor	X		NPWS sub-regional corridor mapped some 150m either side of airstrip. Byron corridor avoids this parcel but lies adjacent to east and north of boundary.
Mapped Threatened Fauna Habitat	X		Most of land to north mapped, small encroachment onto property some 10m av. width by 100m in central north
Mapped Koala Habitat	X		Most vegetation (all of northern veg) mapped as primary habitat. SW mapped as tertiary. In Byron Coast KPoM mapped as within Brunswick heads/Tyagarah KMP and as primary habitat, apart from SW patch.
Threatened Fauna Records	X		1 Koala in SW patch, 2 Wallum Froglets at eastern and SE edges, plus one immediately north of boundary. Wildlife Atlas search + EPBC protected matters search done – see further.
Threatened Flora Records		X	Green-leaved Rose Walnut to immediate south of southern boundary
SEPP 14 (Wetlands)		X	Closest along Simpsons Creek some 950m to NE
SEPP 26 (Littoral Rainforest)		X	Closest Cape Byron headland
SEPP 44 (Koala Protection)	X		Primary habitat mapped most of north and tertiary patch in SW. Koala habitat study shows primary and other
SEPP 71 (Coastal Protection)	X		All within 1 km of coast
Flooding (1 in 100 year)	X		Entire site affected
Bush Fire Category	X		Vegetation Category 1 in SW and NE patches, rest buffer
Acid Sulphate Soils	X		Class 3 entire site
EcoWetlands	X		Minor encroachment on NE boundary
Key Fish Habitats		X	To south and east along drainage lines
National Parks/NR's		X	Tyagarah Nature reserve 1.4km to east
LEP 2014 zoning	X		RU2 and deferred
LEP 1988 zoning	X		1(a) hatched

The map displays land use designations (RU2, DM, SP2) and a proposed road layout. Key features include:

- PACIFIC HIGHWAY**: A major road running vertically through the center.
- TANJUNGSIAO**: A label near the intersection of the Pacific Highway and the Old Brisbane Road.
- OLD BRISBANE ROAD**: A road running diagonally from the bottom left towards the center.
- Land Use Designations**:
 - RU2**: Residential Use 2, shown in tan.
 - DM**: Development Medium Density, shown in grey.
 - SP2**: Special Purpose 2, shown in yellow.
- Proposed Road**: A red line indicating a proposed road or boundary, running diagonally from the bottom right towards the center.

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of the information prior to using it.
Note: The information shown on this map is a copyright of the Byron Shire Council and the NSW Department of Land.

Scale = 1:5,043

Metres 100 200 300 400

(Scale correct at A4 size)

12/09/2014

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of the information prior to using it.
Note: The information shown on this map is a copyright of the Byron Shire Council and the NSW Department of Lands.

Scale = 1:10,129

Metres 200 400 600 800

(Scale correct at A4 size)

 28/07/2014

Byroni LEP 1938
Labels

Byron LEP 1988

 EA General Run!

- [illegible]

Crown Roads

Orange Crown Road

Land Parcels (L)

1.3 PROPOSED DEVELOPMENT

It is proposed to subdivide the existing seven allotments to create a total of 14 lots. Resultant lot sizes would range from approximately 0.1ha to 1.0ha, with a residue lot (containing the airstrip) of some 9.2ha.

Works would involve:

1. Works for subdivision purposes:

- Subdivision and boundary adjustments to create 14 lots where 7 currently exist.
- Provision of services to each lot including:
 - Road widening to form a road reserve 20m wide with a cul-de-sac turn around head (currently around 5m paved surface and 10m between fences), minor earthworks, pavement widening, resurfacing and signage.
 - Piping of reticulated water to each lot from the existing water supply pipeline which runs through proposed Lot 11 and between proposed Lots 4 and 5. This work would require excavation, trenching and laying of pipes within Class 3 acid sulphate soils (1m below surface).
 - Provision of electricity and telecommunications infrastructure to each lot. An above-ground power line runs along the current paved access road, thus it is assumed that such works would be entirely above-ground.
 - Stormwater management through dedicated infiltration zones or piping.
- This stage of the proposed development services is likely to require minor to moderate habitat removal.

2. Works for individual allotment development:

- On-site sewerage management for each lot, requiring cleared areas with sufficient solar access for evapo-transpiration.
- Minor ground level changes to accommodate footings or slab development.
- Erection of large buildings and associated car parking, driveways and facilities.
- Provision of bushfire asset protection zones.
- Boundary fencing.
- Drainage modification works in consideration of flooding issues.
- This stage of the development has potential to require major habitat removal.

SECTION 2: FLORA

The following sections detail the flora survey methodology completed on the subject site and study area. The results of survey within the subject site are also detailed.

Surrounding land has been reasonably well-studied and a desktop literature review included reference to assessment and monitoring reports produced for the East Coast Blues and Roots Festival to the immediate north of the site, the formerly proposed animal shelter on the site, development along Grays Lane and the Plan of Management for Tyagarah Nature Reserve, about 1km to the east. Searches were undertaken for species recorded on the NSW Wildlife Atlas and using the EPBC Protected Matters Search tool. This review enabled a general understanding of the site and the species and communities to be expected.

Survey for the purposes of flora assessment was undertaken on 28th, 29th & 30th July 2014. Survey included:

- Identification and mapping of vegetation communities on site and compilation of a flora species list.
- Targeted searches for threatened flora species and hollow-bearing trees.

2.1 VEGETATION SURVEY METHODOLOGY

To determine the likely and actual occurrence of flora species and plant communities on the subject site, field survey work was undertaken to supplement literature reviews and online database enquiries for the area. The methods utilised for the flora survey are outlined below.

Literature and Database Review

- A review of available literature for the area and surrounds was undertaken to obtain reference material and background information for this study. These documents are listed in the References section of this report.
- A search of the Atlas of NSW Wildlife (NPWS 2014) was undertaken to identify records of threatened flora species located within 10km of the site. This enabled the preparation of a predictive list of threatened flora species that could possibly occur within the habitats found on the site.
- An online Protected Matters search for matters of national significance was undertaken and flora species considered.
- The online database for the National Herbarium of NSW was searched through PlantNet.
- The Northern Rivers Regional Biodiversity Strategy was considered in terms of vegetation communities and their habitat values for the surrounding areas.

Surrounding land has been reasonably well studied and a desktop literature review included reference to assessment and monitoring reports produced for the East Coast Blues and Roots Festival to the immediate north of the site, the formerly proposed animal shelter on the site, development along Grays Lane and the Plan of Management for Tyagarah Nature Reserve, about 1km to the east. Searches were undertaken for species recorded on the NSW Wildlife Atlas and using the EPBC

Protected Matters Search tool. This review enabled a general understanding of the site and species and communities to be expected.

Aerial Photograph Interpretation

Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.

Field Survey

A field survey, which consisted of foot traverses within vegetated areas across the subject site and study area, was conducted according to Cropper (1993) to identify the occurrence of flora species and the extent and location of vegetation communities present. Due to the degraded condition of some of the vegetation within the development boundary, vegetation north and east of the subject site was also sampled as a reference community.

Survey work was undertaken on 28th, 29th & 30th July and the afternoon of 4th August 2014 for the purposes of flora and fauna assessment. Survey included:

- Identification and mapping of vegetation communities on site and compilation of a flora species list.
- Targeted searches for threatened flora species and hollow-bearing trees.

The survey included a detailed site inspection to determine the structural classification of the vegetation community across the subject site and within the study area. Because the vegetation type is relatively consistent throughout (with variation attributable to previous clearing, fire history and condition rather than change in vegetation community) resultant vegetation mapping is reasonably uniform. All flora species encountered on site were recorded. Tree height, crown cover, species composition for the tallest stratum, and height, cover and indicator species for the mid & lower strata were estimated for determining vegetation type.

Specimens of plants not readily identified in the field were collected for identification. This was undertaken through the use of keys and/or consultation with those more expert in the field (Jo Green PhD in flora ecology).

Determination of species composition as well as structural descriptions of the vegetation on the site according to Specht et. al. (1995) was also carried out.

Quadrat Survey

Two 20 X 20 metre quadrats within the area proposed for development were surveyed for flora species. Two additional quadrats, considering only presence and if present, the number of hollow-bearing trees as well as the total number of trees, were located within the south-west and north-eastern habitat patches.

Survey Limitations

Field survey efforts were focused on the property intended for subdivision and particularly areas containing highest ecological values in terms of habitat. Surrounding properties were assessed using aerial imagery and mapping datasets to refine current GIS mapping boundaries not directly surveyed.

Inference of potential presence of listed species was derived based upon the presence of listed species habitats sourced from field surveys undertaken for this project and the adjacent BluesFest site, database searches, inspection of aerial imagery and field experience. The timing and duration of the survey means that more cryptic species such as orchids with underground tubers and smaller summer flowering/fruitle species may not have been captured. In accordance with the *Threatened biodiversity and assessment: guidelines for developments and activities* (DEC 2004), threatened species

presence has been assumed if suitable habitat is present. Assessment of impact on those species have been undertaken in the following section

2.2 VEGETATION COMMUNITY DESCRIPTIONS

Three vegetation communities have been identified within the area of interest. These are listed below.

- 1= Broad-leaved Paperbark open to closed forest
- 2 =Swamp Mahogany open forest to open woodland
- 3= Forest Red Gum floodplain forest
- 4 = Regenerating Open Forest
- 5 =Closed Grassland (exotic)

A flora species list is provided in Appendix 1 while a general description of the vegetation communities is provided in the following sections. Community descriptions follow the Office of Environment and Heritage state-wide classification system (VIS), with reference to the North Coast CMA region. It must be noted that vegetation community boundaries are indistinct and each community merges into the others at various points.

A. Forested Wetlands: Coastal Swamp Forests



1. Broad-leaved Paperbark Open to Closed Forest

VIS Community 27: Broad-leaved Paperbark swamp sclerophyll forest with rainforest elements on coastal floodplains north of the Richmond River, South Eastern Queensland Bioregion AG-ID: 700-629.

Forest Ecosystems of NE NSW equivalent: Ecosystem 112 Paperbark.

General Community Description:

Broad-leaved Paperbark tall to very tall open forest on coastal floodplains north of the Richmond River. Generally found toward the inland side of Pleistocene sand sheets where they meet alluvial floodplains.

Swamp sclerophyll forest dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with a range of rainforest species tolerant of prolonged soil waterlogging present in the mid-stratum or occasionally as sub-dominant canopy species including Umbrella Cheese Tree (*Glochidion sumatranum*), Pink-flowered Doughwood (*Melicope elleryana*), Tuckeroo (*Cupaniopsis anacardioides*), Blue-berry Ash (*Elaeocarpus reticulatus*), Sally Wattle (*Acacia melanoxylon*), Bangalow Palm (*Archontophoenix cunninghamiana*), Willow Bottlebrush (*Callistemon salignus*) and Giant Silkpod Vine (*Parsonsia straminea*). The lower stratum is composed of a wide range of ferns, sedges, and herbs including Wallum Fern (*Blechnum indicum*), Harsh Ground Fern (*Hypolepis muelleri*), Climbing Maidenhair Fern (*Lygodium microphyllum*), Red-fruited Saw Sedge (*Gahnia sieberiana*), *Entolasia marginata*, *Persicaria dichotoma*, Common Reed (*Phragmites australis*), *Gahnia clarkei*, *Lepironia articulata*, *Persicaria strigosa*, *Viola banksii* and Swamp Lily (*Crinum pedunculatum*).

Position: See Figure 9

Characteristic trees

Melaleuca quinquenervia

Other trees

Glochidion sumatranum; *Melicope elleryana*; *Cupaniopsis anacardioides*; *Acacia melanoxylon*; *Archontophoenix cunninghamiana*; *Callistemon salignus*

Characteristic shrubs/vines/epiphytes

Parsonsia straminea; *Lygodium microphyllum*

Characteristic groundcover

Blechnum indicum; *Hypolepis muelleri*

Potential Threatened Flora

Phaius australis, *Phaius tankervillea*, *Persicaria elatior* (V1)



2. Swamp Mahogany Open Forest to Woodland

VIS Community 41: Swamp Mahogany - Tantoon -Tassell Rush forested wetland of waterlogged sandy soils of coastal Pleistocene backbarriers, NSW North Coast Bioregion and South Eastern Queensland Bioregion AG-ID: 70-62. Forest Ecosystems of NE NSW equivalent: Ecosystem 142: Swamp Mahogany.

General Community Description:

A forested wetland that is distributed in sandy waterlogged areas of Pleistocene backbarrier flats along the coast. The dominant tree species is Swamp Mahogany (*Eucalyptus robusta*). The mid layer is comprised of a layer of heath shrubs including *Leucopogon lanceolatus*, Tantoon (*Leptospermum polygalifolium*), Midgenberry (*Austromyrtus dulcis*) and Blueberry Ash (*Elaeocarpus reticulatus*). The lower layer comprises a dense cover of Tassell Rush (*Baloskion tetraphyllum* subsp. *meiostachyum*), *Blechnum indicum* and Saw Sedges (*Gahnia clarkei* and *Gahnia sieberiana*).

Characteristic trees

Eucalyptus robusta

Other trees

Nil

Characteristic shrubs/vines/epiphytes

Leucopogon lanceolatus; *Leptospermum polygalifolium*; *Austromyrtus dulcis*; *Elaeocarpus reticulatus*

Characteristic groundcover

Baloskion tetraphyllum subsp. *meiostachyum*; *Blechnum indicum*; *Pteridium esculentum*; *Entolasia stricta*; *Gahnia clarkei*; *Gahnia sieberiana*

Potential Threatened Flora: Not determined

B. Forested Wetlands: Coastal Floodplain Wetlands



3. Forest Red Gum Open Forest to Tall Open Forest

VIS Community 43: Forest Red Gum - Willow Bottlebrush – Broadleaved Paperbark tall open forest on alluvial floodplains, South Eastern Queensland Bioregion AG-ID:700-500. Forest ecosystems of NE NSW

General Community Description:

Tall to very tall open forest and woodland on near coastal alluvial floodplains of the North Coast. The overstorey is dominated by Forest Red Gum (*Eucalyptus tereticornis*), Willow Bottlebrush (*Callistemon salignus*) and Broad-leaved Paperbark (*Melaleuca quinquenervia*). The mid-stratum is composed of small tree and tall shrubs often with a rainforest character including Tuckeroo (*Cupaniopsis anacardioides*), Sandpaper Fig (*Ficus coronata*), Three-veined Laurel (*Cryptocarya triplinervis*), Cheese Tree (*Glochidion ferdinandi*), Umbrella Cheese Tree (*Glochidion sumatranum*), Native Guava (*Rhodomyrtus psidioides*), *Myrsine howittiana*, Sally Wattle (*Acacia melanoxylon*), Common Lily Pilly (*Acmena smithii*) and *Acronychia oblongifolia*. The understorey is composed of grasses, sedges, herbs and ferns including Native Wandering Jew (*Commelina cyanea*), Arthritis Plant (*Centella asiatica*), Native Violet (*Viola banksii*), Wallum Fern (*Blechnum indicum*), *Fimbristylis dichotoma*, *Paspalidium distans*, Blue Flax Lily (*Dianella caerulea*), Blady Grass (*Imperata cylindrica*), Spiny-headed Mat-rush (*Lomandra longifolia*), Tall Sedge (*Carex appressa*), *Carex maculata*, *Cyperus sphaeroideus*, *Cyperus trinervis* and *Goodenia paniculata*.

Characteristic trees

Eucalyptus tereticornis; *Callistemon salignus*

Other trees

Melaleuca quinquenervia; *Eucalyptus robusta*

Characteristic shrubs/vines/epiphytes

Myrsine howittiana, *Myrsine variabilis*

Characteristic groundcover

Commelina cyanea; *Morinda jasminoides*; *Centella asiatica*; *Viola banksii*; *Blechnum indicum*; *Fimbristylis dichotoma*; *Paspalidium distans*

Threatened Flora

Not determined

2.1. Unaligned vegetation Communities on site



4. Swamp Box Open Forest

Description:

Variable mixed Eucalypt community in which Swamp Box is present in the highest numbers but where dominant species from other named communities are present as co-dominants or sub-dominants. This community represents an intergrading of the three main communities described above.

Canopy species

Lophostemon suaveolens, Eucalyptus tereticornis, Eucalyptus robusta, Callistemon salignus and Melaleuca quinquenervia

Mid-storey

Regenerating canopy species, occasional rainforest species of community 1.

Characteristic shrubs/vines/epiphytes

As per communities 1, 2 and 3.

Characteristic groundcover

Varies from dense understory described within community 2 to more open or patchy ground layer of community 3, to dense leaf litter of parts of community 1 to patches of exotic grassland species of communities 5 and 6.



5. Regenerating very low Open Forest to low Open Woodland

Description:

Variable community which has been previously cleared but where grassland has not been maintained and seedling and sapling regeneration of forest canopy species is occurring

Canopy species

Acacia melanoxylon

Mid-storey

Melaleuca quinquenervia; *Eucalyptus robusta*, *Lophostemon suavelolens*

Characteristic shrubs/vines/epiphytes

Nil

Characteristic groundcover

South African Pigeon Grass (*Setaria sphacelata*) Whiskey Grass (*Andropogon virginicus*), Rhodes Grass, Narrow-leaved Carpet Grass, Bracken Fern (*Pteridium esculentum*).



6. Closed grassland

This community comprises the majority of Lot 1, as well as parts of nominated building envelopes. It consists of cleared forest, which has been maintained to prevent tree growth (to avoid fire risk to the power-lines traversing Lot 1) or has established a dense ground cover limiting regeneration. Grasses are both native and introduced but dominated by *Setaria*, with some Whiskey Grass and native grasses as clumps and in patches, including Blady Grass and Panic grasses.

Position: Proposed Lot 1, either side of power line running north through the site, part Lots 2, 5, 12 and 13.

Canopy: Trees largely absent (except around edges) – one Swamp Box remains on Lot 1 and various saplings and groundcover species intermingle on remaining areas.

Midstorey: Largely absent except where associated with occasional regenerating seedlings and saplings.

Groundcover: South African Pigeon Grass (*Setaria sphacelata*) Whiskey Grass (*Andropogon virginicus*), Rhodes Grass () Narrow-leaved Carpet Grass () Crab Grass () Red Natal Grass () Paspalum () Broadleaf Paspalum () Vasey Grass () Swamp Foxtail Grass () Kikuyu () Buffalo Grass () Blady Grass (*Imperata cylindrica*), Two-colour Panic (*Panicum simile*), Wiry Panic (*Entolasia stricta*).

Surrounding vegetation communities include:

Freshwater Wetlands: Coastal Heath Swamps AG-ID: 70-64
Community 94: Tea-tree tall shrubland of coastal freshwater sand swamp, NSW North Coast Bioregion and South Eastern Queensland Bioregion

Heathlands: Wallum Sand Heaths AG-ID: 700-343
Community 122: Prickly-leaved Paperbark - Wallum Banksia wet heath on coastal sands, South Eastern Queensland Bioregion and NSW North Coast Bioregion

Heathlands: Wallum Sand Heaths AG-ID: 888-40
Community 130: Brush Box Dry Sclerophyll Mallee of North Coast Foredunes, South Eastern Queensland Bioregion

Dry Sclerophyll Forests: Coastal Dune Dry Sclerophyll Forests AG-ID: 700-465
Community 191: Blackbutt - Scribbly Gum - Satinwood -Tassell Rush open forest of sandy waterlogged soils of the far north coast, South Eastern Queensland Bioregion

Other communities known from Tyagarah NR include:

Community 79: Slender Twine-rush - Pale Cord-rush
Sedgeland of North Coast Wallum Swamps, South Eastern
Queensland Bioregion and NSW North Coast Bioregion???

Community 85: Heath Banksia moist and wet heath of coastal
Pleistocene sandplains, South Eastern Queensland Bioregion

Community 86: Prickly Tea-tree Wet Heathland of North
Coast Wallum Swales and Drainage Depressions, South
Eastern Queensland Bioregion and NSW North Coast
Bioregion

Community 88: Knotted Scale-rush - Spear Grasstree Wet
Heathland of North Coast Wallum Swales, South Eastern
Queensland Bioregion and NSW North Coast Bioregion

2.3 THREATENED FLORA SPECIES

A search of the Atlas of NSW Wildlife (OEH 2014) was undertaken to identify records of threatened flora species located within 10km of the site. This list was refined by removing those clearly outside the area and those with particular habitat types not found on site, as well as considering species known to occur nearby through the literature review. The resulting list of species are contained in Table 1.1. This analysis enabled the preparation of a list of threatened flora species that could possibly occur within the habitats found within the subject site, and therefore could be targeted for observation during flora surveys.

E1=Endangered, V=Vulnerable on the schedules of the TSC Act 1995.

TABLE 2.2 POTENTIAL THREATENED FLORA SPECIES/ HABITAT REQUIREMENTS AND SITE COMMENTS			
BOTANICAL NAME	STATUS	CHARACTERISTICS/ PREFERRED HABITAT	COMMENTS
SPECIES KNOWN FROM SIMILAR SWAMP AND FLOODPLAIN COMMUNITIES			
<i>Arthraxon hispidus</i> (Hairy Jointgrass)	V EPBC: V	A creeping grass with branching, erect to semi-erect purplish stems. Occurs over a wide area in south-east Queensland, and on the northern tablelands and north coast of NSW, but is never common. Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Potential to occur on site.
<i>Geodorum densiflorum</i> (Pink Nodding Orchid)	E1	Ground orchid that flowers in December and January and is dormant (the plant is not visible above the ground) during winter. There are thought to be less than 20 populations of Pink Nodding Orchid in NSW, all north of Bundjalung National Park and including Tweed Shire. The species also occurs in Queensland. Habitat is dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand.	Potential to occur on site. The species is cryptic and known to show following disturbance when competition is reduced.
<i>Persicaria elatior</i> (Tall Knotweed)	V	An erect herb to 90 cm tall, with stalked, glandular hairs. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. Normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Some potential to occur on site but habitat not ideal to the species.
<i>Phaius australis</i> (Southern Swamp Orchid)	E1 EPBC: E	This orchid has flower stems up to 2m tall and large broad leaves with a pleated appearance, both arising from a fleshy bulb near ground level. Habitat is swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas. Grows in <i>Melaleuca quinquenervia</i> swamps and in sclerophyll forest, on the coast, at or near sea level, chiefly north from the Evans Head district.	Potential to occur on site.

<i>Phaius tancarvilleae</i> (Lady Tankerville's Swamp Orchid)	E1 EPBC: E	Similar in appearance to the above species, this orchid can be distinguished from the similar Southern Swamp Orchid by the more strongly curved inner tongue of the flower. Widespread, though seriously depleted, through Asia, New Guinea and Queensland and at least formerly, in north-east NSW. Found in swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest.	Potential to occur on site.
SPECIES KNOWN FROM WET SCLEROPHYLL COMMUNITIES			
<i>Drynaria rigidula</i> (Basket Fern)	E1	Grows in a large clump, and has two quite different frond types, lower short, papery 'nest' fronds and green, more erect fronds up to 2 m in length. Grows on plants, rocks or on the ground. Usually found in rainforest but also in moist eucalypt and Swamp Oak forest. In NSW it is only found north of the Clarence River, in a few locations at Maclean, Bogangar, Byron Bay, Mullumbimby, in the Tweed Valley and at Woodenbong.	Some potential to occur on site but habitat not ideal to the species.
<i>Tylophora woolsii</i> (Cryptic Forest Twiner)	E1 EPBC: E	A slender woody climber that grows to 3 m long. The paired leaves are on stalks 7 - 20 mm long, and are an elongated heart-shape with a firm texture. There are two to four tiny glands at the base of each leaf-blade and the stems exude a clear, watery sap if cut. Found from the NSW north coast and New England Tablelands to southern Queensland, but is very rare within that range. This species grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. The species has been recorded in Mullumbimby close to the Brunswick River.	Some potential to occur on site but habitat not ideal to the species.
SPECIES KNOWN PRIMARILY FROM RAINFOREST COMMUNITIES			
<i>Acacia bakeri</i> (Marblewood)	V	Large wattle tree that grows north from the Mullumbimby area; rare. Grows in wet sclerophyll eucalypt forest and rainforest.	Suitable habitat not present
<i>Archidendron hendersonii</i> (White Lace Flower)	V	A tree to 18 m tall, with light-brown bark and bi-pinnate leaves, it is distributed from north Queensland south to the Richmond River in north-east NSW. It occurs in riverine and lowland subtropical rainforest, littoral rainforest, coastal cyprus pine forest and their ecotones. It is found on a variety of soils including coastal sands and those derived from basalt and metasediments.	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds.
<i>Corokia whiteana</i> (Corokia)	V EPBC: V	Corokia is a shrub or small tree to 4 m tall. It occurs only in north-east NSW and has a highly restricted distribution. Originally known from a single population in Nightcap NP, the species is now known to be more widespread and records in Byron Shire occur in Wilsons Creek; Huonbrook;	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds.

		Brunswick Heads NR; Billinudgel NR and the northern tip of Tyagarah NR (in littoral rainforest grading with swamp forest). A number of records also occur close to the coast near Tandy's Lane (in vegetation mapped as Camphor dominated and Acacia regrowth), within 3km of the subject site. The inland populations are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	
<i>Cryptocarya foetida</i> (Stinking Cryptocarya)	V EPBC: V	A small to medium-sized tree growing to 20 m tall, with a dark green crown, and brown, slightly fissured bark. Found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor Laurel forest usually on sandy soils, but mature trees are also known on basalt soils. The seeds are readily dispersed by fruit-eating birds, and seedlings and saplings have been recorded from other habitats where they are unlikely to develop to maturity. Though seedlings can be fairly numerous, few mature trees are known.	Unlikely as the species is a rainforest specialist.
<i>Davidsonia jerseyana</i> (Davidson's Plum)	E1 EPBC: E	Davidson's Plum grows to 10 m tall, either with a single unbranched stem or several stems arising from the base, large, hairy leaves and edible fruit arising from the stem. Restricted to north-east NSW to as far south as Wardell. Habitat is lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m). Many trees are isolated in paddocks and on roadsides in former rainforest habitats. Confined to subtropical rainforest in coastal areas from the Brunswick R. to the Tweed Valley; rare	Considered unlikely to occur due to the lack of a true rainforest community on the site or immediate surrounds Distinctive species likely to be noticed even at seedling stage – not recorded on site during survey.
<i>Diospyros mabacea</i> (Red-fruited Ebony)		Red-fruited Ebony is generally a small tree, though it can grow to 25 m tall. The stem is often crooked, and has dark, scaly bark. Occurs only in north-east NSW. It is found in a few stands on the Tweed and Oxley Rivers, upstream from Murwillumbah, on Stotts Island in the lower Tweed River and one other small population west of Mullumbimby on the Brunswick River. The largest population is in Limpinwood Nature Reserve. It usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial. In Byron Shire records are from Main Arm, The Pocket and Mullumbimby subtropical rainforest.	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds
<i>Endiandra muelleri subsp bracteata</i> (Green-leaved Rose Walnut)	E1	A tree up to 30 m tall with brown bark, often in loose round plates. Twigs and branchlets are covered in hairs. The moderately glossy leaves are oval with three to five pairs of side veins. Flushes of new growth are pinkish-green. Occurs in Queensland and in north-east NSW south to Maclean but is sparsely distributed within this range. Occurs in subtropical and warm temperate	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds

		rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats. Records are usually from poorer soils derived from sedimentary, metamorphic or acid volcanic rocks and the species is generally recorded at lower altitudes. Nearby records include two along Simpsons creek beyond Andersons Lane and one just to the south of Tyagarah airstrip in moist sclerophyll forest adjoining rainforest.	
<i>Floydia prealta</i>	E1	This tree grows to 35 m tall, with rough, brown, slightly wrinkled bark. Small scattered populations distributed from Gympie in Queensland to the Clarence River in north-east NSW. Riverine and subtropical rainforest, usually on soils derived from basalt. Records in Byron Shire are from Middle Pocket and Broken Head.	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds and sandy, rather than basaltic, soil.
<i>Grevillea hilliana</i>	E1	White Yiel Yiel is a rainforest tree 8 – 30 m tall with young leaves deeply lobed. Occurs north from Brunswick Heads on the north coast of NSW and in Queensland. The only populations currently known in NSW are near Brunswick Heads, on the slopes of Mt Chincogan, and in patches of remnant habitat in Tweed Shire, particularly around Terranora. White Yiel Yiel grows in subtropical rainforest, often on basalt-derived soils.	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds and sandy, rather than basaltic, soil.
<i>Gossia fragrantissima</i> (Sweet Myrtle)	E1 EPBC: E	A multi-stemmed shrub or small tree, about 4 –10 m tall. The bark is rough, brown and fissured to flaky. Its small, glossy leaves usually have a tiny point at the apex and are paired on the stem. Occurs in south-east Queensland and in north-east NSW south to the Richmond River. Mostly found on basalt-derived soils. Habitat is Dry subtropical and riverine rainforest. As it can coppice from roots left in the ground when rainforest is cleared, it is found at several sites as isolated plants in paddocks or regrowth.	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds and sandy, rather than basaltic, soil.
<i>Lindsaea brachypoda</i> (Short-footed Screw Fern)	E1	A small fern that grows on the ground or on rocks. It can reach about 30 cm tall, but is usually much smaller. In NSW it is mainly found in a few locations north from Minyon Falls in Nightcap National Park. Records exist for Tumbulgum, Mullumbimby and Mooball. Requires very moist habitats in subtropical or warm-temperate rainforest or palm forest.	Habitat not suitable
<i>Owenia cepiodora</i> (Onion Cedar)	V EPBC: V	Onion Cedar is a tall evergreen tree, up to 30 m, with a dense glossy dark-green crown. Habitat is subtropical and dry rainforest on or near soils derived from basalt, known from Bangalow to McPherson Range.; rare NSW.	Unlikely due to the lack of rainforest on the site and sandy, rather than basaltic, soil.

<i>Randia moorei</i> (Spiny Gardenia)	E1 EPBC: E	Spiny Gardenia is a tall shrub or small tree 3 - 8m tall, often with coppice shoots and root suckers at the base. The paired leaves are mostly oval-shaped and axillary spines are often present. The species is found from Lismore to the Logan River in south-east Queensland. Sparsely distributed, with most records in the Tweed and Brunswick areas. Spiny Gardenia occurs in subtropical, riverine, littoral and dry rainforest. In NSW, Hoop Pine and Brush Box are common canopy species. It is found along moist scrubby water courses at altitudes up to 360 m asl, with most records below 100 m asl.	Unlikely due to the lack of a true rainforest community on the site or immediate surrounds
<i>Senna acclinis</i> (Rainforest Cassia)	E1	Rainforest Cassia is a shrub to 3 m tall with compound leaves to 15 cm long, each with up to 6 pairs of oval-shaped leaflets. Grows on the margins of subtropical, littoral and dry rainforests, north from the Wollongong area (Balgownie) to Townsville. Often found as a gap phase shrub.	Habitat not suitable for the species.
<i>Syzygium hodgkinsoniae</i> (Red Lilly Pilly)	V EPBC: V	This is a small tree to about 11 m tall. Its paired leaves are oval shaped with a short blunt point at the tips. A restricted range from the Richmond River to Gympie. Locally common in some parts of its range, but otherwise sparsely distributed. Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils.	Possible. Coastal Floodplain wetlands and coastal swamp forests are included in the species linked vegetation classes. Not found during flora survey.
<i>Syzygium moorei</i> (Coolamon)	V EPBC: V	Coolamon is a tree growing up to 40 m tall, with dense dark foliage and grey bark with papery scales. The pink flowers and white fruits are clustered directly on older leafless branches and the trunk of the tree. Found in the Richmond, Tweed and Brunswick River valleys in north-east NSW and with limited occurrence in south-east Queensland. Durobby is found in subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees.	Possible. Coastal Floodplain wetlands and coastal swamp forests are included in the species linked vegetation classes. Not found during flora survey.
<i>Tinospora tinoporoides</i> (Arrow-head Vine)	V	A tall woody climber that has triangular leaves with broadly notched bases. It occurs in wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils north from the Richmond River.	Habitat not suitable for the species.
<i>Uromyrtus australis</i> (Peach Myrtle)	E1 EPBC: E	Peach Myrtle is a shrub or small tree growing up to 12 m tall, the trunk often crooked and covered in brown scaly or flaky bark. It often forms clumps of plants as it grows from root suckers and coppice shoots. Found only in Nightcap and Mount Jerusalem National Parks and Whian Whian State Conservation Area, west of Mullumbimby. Habitat is warm temperate rainforest on less fertile soils derived from rhyolite rock. Often associated with Coachwood (<i>Ceratopetalum apetalum</i>).	Habitat not suitable for the species

<i>Xylosma terrae-reginae</i> (Queensland Xylosma)	E1	Queensland Xylosma is a tall shrub or small tree growing to 15 m tall. Its trunk is crooked with low branches. The species is found along coastal areas in north-east NSW from Ballina, north to the Maryborough region. Habitat is littoral and subtropical rainforest on coastal sands or soils derived from metasediments. Known from Brunswick Heads Nature Reserve.	Habitat not suitable for the species
SPECIES KNOWN PRIMARILY FROM OTHER COMMUNITIES			
<i>Harnieria hygrophiloides</i>	E1	A large herb or small shrub that grows to about 1.5 m in height. Occurs in NEQ and southwards to north-eastern New South Wales. Altitudinal range from 500-1040 m. Usually grows in the drier types of rain forest and wet sclerophyll forests adjacent to rain forest.	Habitat on site not suitable due to low altitude on floodplain. Species not associated with Swamp Forests or Floodplain Wetlands.

*Information adapted from OEH threatened species profiles and Flora online.

The parts of the site subject to quadrat survey were thoroughly checked for potential threatened flora species. No threatened flora species as listed within the relevant Schedules of the TSC Act (1995) were observed on those parts of the site during survey.

Following detailed consideration of the larger site and species listed in Table 2.2, it is considered that there is suitable and / or sub-optimal habitat on the site for the following species:

- *Arthraxon hispidus* (Hairy Jointgrass)
- *Geodorum densiflorum* (Pink Nodding Orchid)
- *Phaius australis* (Southern Swamp Orchid)
- *Phaius tancarvilleae* (Lady Tankerville's Swamp Orchid)
- *Syzygium hodgkinsoniae* (Red Lilly Pilly)
- *Syzygium moorei* (Coolamon)

2.4 ENDANGERED FLORA POPULATIONS AND EEC'S

There are no Endangered Populations of flora known from the Byron Shire or Tyagarah area.

Two potential Endangered Ecological Communities occur on site. These are described in Table 2.3 below.

TABLE 2.3 POTENTIAL ENDANGERED ECOLOGICAL COMMUNITIES CHARACTERISTICS		
EEC NAME	EEC CHARACTERISTICS	COMMENT
Swamp Sclerophyll Forests on coastal floodplain (SSF)	A community that generally has several layers of vegetation, including trees, shrubs, groundcovers and wetland plants such as reeds and sedges. Generally found close to standing water on soils that are either waterlogged or subject to periodic flooding or inundation. It is usually an open to closed forest with a shrubby or reedy/ferny understorey, although in some areas the tree layer is low and dense and the community takes on the structure of scrub. <u>'Key Indicators'</u> for Swamp Sclerophyll Forest: <i>Is the site on the coastal floodplain of the NSW North Coast, Sydney Basin or South East Corner bioregion?</i> YES <i>Is the site associated with humic clay or sandy loams soils?</i> AEOLEAN SAND with some alluvial influence. <i>Is the site subject to waterlogging and/or below the highest flood level?</i> YES, mapped as flood-prone land. <i>Are any of the tree species present at the site listed as characteristic of Swamp Sclerophyll Forest in the table?</i> YES, dominated by <i>Melaleuca quinquenervia</i> with <i>Eucalyptus robusta</i> and <i>Lophostemon suaveolens</i> common. <i>Are any of the shrub and/or groundlayer species listed as characteristic in the table present?</i> YES, 11 out of 15 listed shrubs and 19 out of 31 listed groundlayer species.	Alignment with the ID guidelines confirms this EEC covers the area of the site mapped as Broad-leaved paperbark open to closed forest and Swamp Mahogany open forest to woodland (see Figure 9)
Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion (SCFF)	Occurs on the coastal floodplains of the North Coast of NSW. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. siderophloia</i> (Grey Ironbark), <i>Corymbia intermedia</i> (Pink Bloodwood) and, north of the Macleay floodplain, <i>Lophostemon suaveolens</i> (Swamp Turpentine). Occupies central or marginal parts of	Alignment with the ID guidelines confirms this EEC covers the area of the site mapped as Forest Red Gum Open Forest, and intergrades with the above community.

	floodplains and sandy flats, including Pleistocene back-barrier flats; habitats where flooding is periodic and soils are rich in silt and sand, sometimes humic, and show little influence of saline ground water. Associated with clay loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m, but may occur on localised river flats up to 250 m elevation. <u>'Key Indicators' for SCFF</u> <i>Is the site north of Port Stephens?</i> YES <i>Is the site on the coastal floodplain?</i> YES <i>Is the tree layer made up of mixed eucalypts?</i> YES <i>Does the tree layer contain any of the following: Forest Red Gum, Grey Ironbark, Pink Bloodwood or, north of the Macleay floodplain, Swamp Turpentine?</i> YES, Forest Red Gum, Swamp Turpentine and occasional Pink Bloodwood. <i>Are rainforest trees or shrubs scattered throughout?</i> YES, although exotic grass species are competing. <i>Are there relatively low numbers of Casuarina species, Melaleuca species and Swamp Mahogany?</i> YES, apart from intergrading areas with other communities.	
--	--	--

*Information adapted from OEH threatened species profiles and ID Guidelines.

SECTION 3: FAUNA

A full fauna survey of the site was impractical due to the time constraints imposed on this project and the relative abundance of information from nearby fauna surveys available for extrapolation to the site. Fauna survey methods used were therefore non-invasive and did not involve trapping. This process means that presence of threatened species must be assumed if suitable habitat is present. The following section describes the fauna survey and the habitat assessment of the site.

3.1 FAUNA SURVEY METHODOLOGY

Literature Review

A detailed review of local ecological surveys and a search of the Atlas of NSW Wildlife (OEH 2014) and the Protected Matters under the federal EPBC Act was undertaken to identify records of threatened fauna species located within 10km of the subject site. Broader consideration of species associated with the Coastal Floodplain Wetlands and Coastal Swamp Forest communities was also undertaken.

Fauna Survey

Fauna survey work was completed on 28th, 29th & 30th July and the afternoon of 4th August 2014 for the purposes of flora and fauna assessment. Detailed quantitative fauna surveys were not undertaken as part of this assessment. Instead a rapid and opportunistic field survey strategy was employed to identify fauna species presence / absence within the designated time frame and within the prevailing weather conditions and season (winter) at the time of survey. It is highly likely that additional comprehensive assessment would result in additional fauna species being identified within the study area.

Survey included:

1. Habitat assessment and searches for evidence of species present included consideration of, and searches for, the following habitat features on the site. The search area concentrated on the proposed subdivision area but included random meanders within vegetation to the north.
 - hollow-bearing trees, including dead stags or large trees with basal cavities
 - bush rock and rocky outcrops
 - natural burrows,
 - logs, leaf litter, understorey density
 - wetlands, streams, rivers, dams and other water bodies,
 - dens used by yellow-bellied gliders, squirrel gliders and brush-tailed phascogales
 - yellow-bellied glider and squirrel glider sap feed trees,
 - distinctive scats (e.g. those of the spotted-tailed quoll or koala)
 - latrine and den sites of the spotted-tailed quoll,
 - searches for signs of likely bird activity such as nesting or hollow tree use. Signs of feeding such as the characteristic chew marks of *Allocasuarina* sp. cones
 - flying-fox camps,
 - Microchiropteran bat tree roosts,
 - Microchiropteran bat subterranean roosts (caves, culverts, tunnels),
 - swift parrot and regent honeyeater feed or nest trees,
 - winter-flowering eucalypts,
 - permanent drains soaks and seepages,
 - “digs” and/or “scratchings”
 - preferred koala food trees as listed in the Byron Coast Koala Habitat Study and Appendix 2 of the approved Koala Recovery Plan
 - areas that can act as corridors for plant or animal species.

- connectivity value of the site
- likely niches such as dense undergrowth, around trees, under logs and rocks, and aquatic drain and gully habitats for amphibian and reptile species.

Habitat attributes of the site were recorded so as to determine whether particular threatened species habitat requirements may be met on site. Species or evidence of species presence was sought. Results of habitat assessment are contained in Table 3.1.

2. Bird surveys undertaken near dawn (total of eight person hours) and dusk (two person hours). This involved walking random meanders through and around the edges of the site subject to subdivision (Figure 8) and recording any species of avifauna seen or heard within a 20m radius, or seen flying overhead. Unfamiliar species were photographed where possible and identified through field references and the *Australian Birds* (Morcombe and Stewart 2014) phone application. A small tape recorder was also used each morning in a fixed location (altered each day) for the survey period and unfamiliar calls compared with Dave Stewart's CD *Birds of Subtropical Eastern Australia*. The habitat available (considering the feeding, roosting and nesting requirements of various local bird species) is discussed in the Fauna Results section following and the final species list is contained within Appendix 2.
3. Amphibian survey near dusk following light rain (2 person hours). This involved listening for any species calling from areas of the site where water was expected to collect in drains or low spots (Figure 8). Unfortunately, due to the extended dry period prior to survey and the short, light nature of rain received, no frog calls were heard. Thus the list of frog species expected has been taken from adjacent surveys, atlas records and habitat assessment.
4. Targeted koala survey using the Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) to search for faecal pellet evidence and subsequent transects when faecal pellets were located. Two locations were chosen as representative of the two communities dominated by preferred koala food trees (Forest Red Gum and Swamp Mahogany) where a centre tree was selected and marked with flagging tape. Three people then searched for koala faecal pellets within a 1m radius of the thirty nearest trees having a diameter at breast height (dbh) of 100mm or greater. Since pellets were located at both sites, two transects were then completed (Figure 8) by three people walking 10m apart for 125m north and south of the centre tree (or east and west for the second site due to the layout of the site) and searching for koalas in all trees within 10m either side of their route. In total this equated to 2 x 1ha (250m x 40m) transects considered to cover almost the whole of the forested area subject to development. Results are discussed in the Fauna Results section following and SAT survey results are shown in Appendix 3.
5. Scat, diggings and track analysis was undertaken during other survey through observation and examination, with results checked against the reference *Tracks, Scats and other Traces – a field guide to Australian Mammals* (Triggs 2012).
6. Some smaller logs and tin sheets were overturned in an attempt to discover any reptiles or small mammal sheltering beneath.
7. Deployment of fixed cameras in two locations designed to capture images when triggered by diurnal or nocturnal movement.

Survey Limitations

Habitat survey was limited to three days on 28th, 29th, and 30th July 2014, with a late afternoon/dusk visit on 4th August following light rainfall that day. Survey for bird species was undertaken in the early morning (6am to 8am) for a total of eight person hours. Amphibian survey was attempted only on one late afternoon until nightfall, with a repeat visit on the morning of 1st September following a period of prolonged rainfall such that water remained in the airstrip northern drain. Survey season was limited to late winter and to fine, dry weather or light rain following a prolonged dry spell.

Field survey efforts were focused on the property intended for subdivision and particularly areas containing highest ecological values in terms of habitat. Surrounding properties were assessed using aerial imagery and mapping datasets to refine current GIS mapping boundaries but were not directly surveyed.

Detailed quantitative fauna surveys (trapping, capture/recapture and abundance counts) were not undertaken as part of this assessment. This means that whilst species diversity for the 'snapshot' survey can be discussed, abundance of individual species on the site cannot. Fauna discussion relies on sightings and/or calls, habitat types and indicators of particular species or faunal groups as discussed above.

Survey methods and timing limited the capture of nocturnal species, those that are more cryptic such as reptiles during aestivation in colder temperatures, and late spring/summer migratory species. Inference of potential presence of listed threatened species was therefore derived based upon the presence of listed species' habitats sourced from field surveys undertaken for this project, previous studies on the airport land and the adjacent BluesFest site, database searches, inspection of aerial imagery and field experience. This means that species for which suitable habitat occurs on the subject site or in the study area were not excluded from further assessment based on lack of detection. Presence has been assumed if suitable habitat is present and assessments of impact on those species have been undertaken in the Section 4.

3.2 FAUNA HABITATS

The Northern Rivers Regional Biodiversity Strategy recognises that the Region is a population stronghold for many species and also provides important habitat for trans-national migratory birds (Gilmore & Parnaby 1994). It is also significant for nomadic and over-wintering insectivorous birds and microchiropteran bats, as well as nectivorous and frugivorous birds and megachiropteran bats (NPWS 1995b).

The subject site contains a range of fauna habitats associated with Coastal Swamp Forests and Coastal Floodplain Wetlands (which grade into Wallum Heath and drier sclerophyll communities beyond the eastern edge of the subdivision site), as well as native regrowth and (largely exotic) grassland vegetation communities. The majority of the subject site indicates former disturbance through prior clearing, bushfire and grazing, meaning mature and senescent trees are limited in number. Regeneration of native species (evident of the former floodplain communities) is well-advanced except where exotic grassland dominates to smother seedling emergence.

The swamp sclerophyll forest vegetation is of faunal significance because of the large amounts of blossom produced by eucalypts, melaleucas and related species and in turn large amounts of nectar; a critical resource for many insects, birds, arboreal mammals and flying foxes. High nectar level forests generally support higher densities of birds and mammals which in turn support high numbers of predators such as owls, quolls and raptors. In this case, presence of higher order species is likely to be limited by lack of medium and large tree hollows.

Fleshy fruit-bearing species are mostly ground layer species such as *Dianella* and extensive *Gahnia*, although *Geebung*s, *Cheese Trees*, *Tuckeroos* and other limited rainforest species occur around community edges. A variety of seed (grass and tree) and insect resources are available on site.

Shelter at ground-level is suitable for a number of species due to the prevalent dense understorey provided by *Gahnia* and *Tassel sedge* species. A number of stick-nests (possibly drays) were observed in taller eucalypts during survey.

Hollow-bearing trees of the forest communities provide suitable roost, den and breeding opportunities for a range of locally occurring bird, small arboreal mammal and micro-chiropteran bat species. Hollows on the site subject to proposed development are limited to branch hollows with occasional larger lower trunk hollows accessible from ground level. Overall, hollow-bearing trees are not common and are limited in size due to the relatively young age of most trees. Hollows which are present are primarily branch hollows. Quadrat data, as shown in Table 3.2, was used to survey the hollow tree abundance within the subject site.

**TABLE 3.1
HABITAT ELEMENTS**

Habitat Element/Feature	Comment
Native vegetation communities	Three native forest communities and two derived communities occur in the study area.
Presence of dense understorey and groundcover vegetation	Understorey/ground layer elements are generally dense and consist of Gahnia and Tassel sedge species, as well as exotic grassland where the tree layer has been removed.
Presence of hollow-bearing trees, including dead stags or large trees with basal cavities	Hollow-bearing trees are present on site, mainly branch hollows with one dead stag and occasional trunk basal hollows. Fallen timber common and some large piles evident.
Presence of preferred koala food trees as listed in Appendix 2 of the approved Koala Recovery Plan (primary and secondary)	Common - two species (Forest Red Gum and Swamp Mahogany) present on site in moderate and high numbers.
Presence of scratches or feeding scars on tree trunks	Koala scratches and occasional other feeding scars present .
Presence of large stick nests indicative of raptor presence	Three stick nests noted within the subject site although all were smaller than those expected for raptor species.
Presence of rocky outcrops and/or extensive exposed rocky areas favouring reptiles	None present in the study area.
Presence of caves, culverts or disused buildings suitable for roosting of microchiropteran bat species	None found within the study area or subject site.
Presence of wetlands, creeklines, estuaries, mudflats, mangroves and riparian vegetation	Floodplain wetland and swamp forest covers much of the site. Tyagarah Creek and associated drainage lines occur to the immediate south of airstrip. Simpsons Creek estuary lies some 1km beyond the north-eastern property boundary.
Presence of dams ponds, lakes and/or other natural or constructed permanent water sources	Dam present on BluesFest site to the north, none on site.
Presence of permanent soaks and seepages	Permanent soaks and seepages inferred from wetland communities. Airstrip drain runs south of the development site along the northern and eastern edges of the airstrip.
Presence of sandy and/or friable soils suitable for burrowing or digging	Soils diggings noticeable and frequent.
Presence of interconnected vegetation remnants (internal and external to site)	A good degree of connectivity, particularly for more mobile species, exists to the north and east; eventually connecting through to Tyagarah Nature Reserve. Remnant vegetation to the south is separated by Tyagarah airstrip which is grassed.
Presence of extensive forested habitat with limited exposure to clearing, fragmentation and associated edge effects	Vegetation on the site has been previously cleared and burnt and the remaining larger trees on site are estimated at some 80 year of age. Extensive regrowth is present.

--	--

TABLE 3.2
HOLLOW BEARING TREE DATA

	Total trees	Total trees with hollows	% Hollow Bearing Trees
Quadrat 1 (20m x 20m)	71	0	0%
Quadrat 2 (20m x 20m)	52	8	5%

Very few hollows were found within the vegetation south of the existing entrance road where older trees are present but not yet of a maturity to develop hollows. The southern end of this vegetation patch has been managed to maintain a safe flight path adjacent the airstrip and taller trees have been removed from this area (McAlpin, 2008). Hollow present on the remainder of the site are branch hollows with a few stags left standing.

The site subject to the development lacks permanent water or riparian vegetation, although floodplain vegetation covers much of the site and regular flooding of the area is known. A permanent swale drain some 2m wide has been constructed along the northern boundary of the airstrip to improve airstrip drainage. It contained no standing water at the time of initial survey and was thus reassessed following prolonged rainfall. As discussed, Tyagarah Creek and associated drainage lines occur to the immediate south of the airstrip and Simpsons Creek estuary lies some 1km beyond the north-eastern property boundary. The movements of amphibians through the subject site from other areas of suitable habitat is likely to be limited to periods of heavy rain and flooding, as evidenced by Atlas records collected during 2012/13, a known wet period (see photo below illustrating the extent of inundation over the airstrip in 2012).



Floodwaters June 11th 2012
(Image reproduced from Fitzgerald 2013)

Reptile habitat is present in abundance, though movement may be restricted by the very dense and prickly nature of the understorey over much of the site. Terrestrial mammals are restricted by the presence of the Pacific Highway to the west and cleared grazing/festival land in the surrounds. The (only) few residences nearby limit high pet numbers and little activity (no planes) occurs at night, meaning nocturnal species experience only the music festival noise disturbance (two annually at present).

A complete list of fauna species recorded on site is contained in Appendix 2.

3.3 THREATENED FAUNA SPECIES

A search of the Atlas of NSW Wildlife (OEH 2014) and the EPBC Protected Matters database (Dept Env. 2014) was undertaken to identify records of threatened fauna located within 10 kilometres of the subject site. This identified a number of threatened species that may be present in the area. The list was supplemented by species likely to use Coastal Floodplain Wetlands and Coastal Swamp Forests.

Details on those threatened fauna species recorded as occurring within the local area are provided in Table 3.3. Comments are also provided on the suitability of habitat within the subject site for each of these threatened species. A final list of species considered at potential risk from the proposal is contained at the end of this section.

TABLE 3.3
RECORDED AND POTENTIAL THREATENED FAUNA OF THE AREA

Common Name <i>Scientific Name</i>	STATUS TSC Act (EPBC)	HABITAT REQUIREMENTS	COMMENTS
Mitchell's Rainforest Snail <i>Thersites mitchellae</i>	E (CE)	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils; found amongst leaf litter on the forest floor and often associated with bangalow palms.	Swamp Forest represents potential habitat where dense understorey absent and leaf litter accumulated. Few Bangalow Palms present. Site too dry at time of survey (and periodically) to support this species on a continuing basis. Preferred habitat absent.
Olongburra Frog <i>Litoria alongburensis</i>	V (V)	Paperbark swamps and sedge swamps of coastal wallum country characterised by acidic water bodies. Breeding habitat is characterised by the presence of emergent sedges, with upright species such as <i>Baumea</i> spp. and <i>Schoenus</i> spp.	Recorded in drain east of airstrip in 2008 but not in 2013 or present study. Permanent standing water and breeding habitat not present in development zone.
Wallum Froglet <i>Crinia tinnula</i>	V	A wide range of habitats usually associated with acidic swamps on coastal sand plains. Typically occur in sedgelands and wet heathlands. Also found along drainage lines within other vegetation communities and disturbed areas, occasionally in swamp sclerophyll forests. Breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches.	Known from the airport land, numerous records along southern airstrip drain. Potential habitat within drainage line containing Paperbarks. Suitable habitat will be largely retained in Council ownership.
Black Bittern <i>Ixobrychus flavicollis</i>	V	Dense vegetation fringing and in streams, swamps, tidal creeks and mudflats, particularly amongst Swamp She-oaks and mangroves.	Recorded at the BluesFest site to the north. Suitable habitat absent from development area.
Brolga <i>Grus runcunda</i>	V	Shallow swamps, floodplains, grasslands and pastoral lands.	Recorded on open grassed airport land in previous survey. No suitable habitat will be impacted.
Bush Stone Curlew <i>Burhinus grallarius</i>	E	Open forests, savanna woodlands, sometimes dune scrub, with a sparse grassy groundlayer and fallen timber.	Suitable habitat present, however, high levels of disturbance and dogs are likely to discourage this shy species. Not recorded in the local Tyagarah area or nearby surveys.
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>	E	Permanent watercourses, wetlands, estuaries and shallow floodwaters.	No suitable habitat will be impacted within development area.
Comb-crested Jacana <i>Irediparra gallinacea</i>	V	Among vegetation floating on slow-moving rivers and permanent lagoon, swamps, lakes and dams.	No suitable habitat within development area.
Pale-vented Bush-hen <i>Amaurornis moluccana</i>	V	Tall dense understorey vegetation on margins of freshwater streams or wetlands.	No suitable habitat on development site.
Eastern Grass Owl <i>Tyto longimembris</i>	V	Areas of tall grass, including grass tussocks, in swampy areas, grassy	Suitable habitat present in exotic grassland dominated by <i>Setaria</i> and

		plains, swampy heath, and in cane grass or sedges on flood plains	within dense sedgeland understorey.
Eastern Osprey <i>Pandion cristatus</i>	V	Coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water	Suitable habitat absent from subject site, recorded flying overhead.
Glossy Black Cockatoo <i>Calyptorhynchus lathamii</i>	V	Open forests with <i>Allocasuarina</i> species and hollows for nesting. Distribution Limit – N-Tweed Heads. S-South of Eden.	Some suitable foraging habitat in <i>Allocasuarinas</i> planted along eastern fenceline. No chewed cones apparent here. Large hollows above ground-level not available in the subject site, although occur nearby.
Grey-crowned Babbler (eastern subspecies) <i>Pomatostomus temporalis temporalis</i>	V	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	Recorded to the east of the subject site where Brushbox is prevalent. Foraging and roosting habitat present in the east of the site.
Little Eagle <i>Hieraaetus morphnoides</i>	V	Open Eucalypt forest, woodland or open woodland. Nests in tall living rees within a remnant patch, where pairs build a large stick nest in winter.	Forage and nesting habitat present. No tall trees will be removed.
Rose-crowned Fruit-dove	V	Mainly rainforests, coastal swamp forests.	Minor small rainforest tree removal along entrance road.
Square-tailed Kite <i>Lophoictinia isura</i>	V	Coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds especially honeyeaters, and most particularly nestlings. Nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Suitable foraging habitat, roosting habitat absent from subject site.
Swift Parrot <i>Lathamus discolor</i>	E (E)	Occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Breed in Tasmania in large hollows.	Feeding, roosting habitat present in Swamp Mahoganies. No impact to this tree species.
White-eared Monarch <i>Carterornis leucotis</i>	V	Occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They breed from about September to March, usually nesting high in the canopy, and often at the edge of patches of rainforest.	Recorded on site during this and previous surveys. Impacts considered in the following section.
Wompoo Fruit-dove <i>Ptilinopus magnificus</i>	V	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Locally nomadic - following ripening fruit. Nest in a flimsy platform of sticks on a thin branch or a palm frond, often over water.	Preferred habitat absent from development area.

Common Planigale <i>Planigale maculata</i>	V	Inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. Diversity of habitat appears important and often found in ecotones.	Sub-optimal habitat present, due to lack of permanent water.
Koala <i>Phascolarctos cinereus</i>	V (V)	Inhabits both wet & dry eucalypt forest and woodlands containing preferred feed trees. Known to have an affinity to home range and to seek stable populations.	Older scats present on site with low use recorded in Sw habitat and high use at eastern edge. Optimal habitat present. Appears the eastern edge of the site had very high use in 2008 (McAlpin). Local population decline apparent through Bluesfest monitoring. All Koala food trees will be retained.
Grey-headed Flying Fox <i>Pteropus poliocephalus</i>	V (V)	Canopy trees of rainforest or riparian/estuarine with sufficient forage within 40km.	Forage available but no suitable roosting habitat present. Nearest known camp is at Myocum, well within known nightly forage distance. This species is expected to utilise parts of the site for faoraging.
Common Blossom Bat <i>Syconycteris australis</i>	V	Often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps.	Recorded from BluesFest site. Suitable forage habitat present on site, though no preferred roost site (rainforest). No impact to roosts, minor loss of paperbarks along road edge.
Long-nosed Potoroo <i>Potorous tridactylus</i>	V (V)	Coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature	Recorded from Tyagarah Nature Reserve in the past. Preferred habitat absent, although dense undetorey and diversity of habitat present. No impact on these areas.
Eastern Bentwing Bat <i>Miniopterus schreibersii oceanensis</i>	V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures	No suitable roost sites present.
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	V	Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects. Live or dead hollow-bearing trees, under exfoliating bark, buildings, variety of habitats most commonly tall wet forest	Non-optimal habitat present.
Southern Myotis <i>Myotis macropus</i>	V	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools	No suitable roosts due to lack of permanent water.
Eastern Long-eared Bat <i>Nyctophilus bifax</i>	V	Lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Coastal rainforest and patches of coastal scrub are particularly favoured. Roosts in tree hollows, the hanging foliage of palms,	Suitable habitat present on site. Recorded from Bluesfest site. All trees with hollows will be protected.

		in dense clumps of foliage of rainforest trees, under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings.	
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	V	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter.	Suitable habitat present on site. Recorded from Bluesfest site. All trees with hollows will be protected.
Yellow-bellied Sheathtail Bat <i>Saccolaimus flaviventris</i>	V	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Suitable habitat present on site. Recorded from Bluesfest site. All trees with hollows will be protected.

*Information adapted from DEC threatened species profiles and reference texts listed.

Following detailed consideration of the larger site and threatened species habitat and lifecycle requirements (Table 3.2), it is considered that there is suitable habitat on the site for the threatened species listed below. These species have either been recorded on site or are considered likely to use parts of the site for at least part of their lifecycle requirements.

- Koala
- Wallum Froglet
- Olongburra Frog
- White-eared Monarch
- Rose-crowned Fruit-dove
- Eastern Grass Owl
- Glossy Black Cockatoo
- Grey-headed Flying-fox
- Common Planigale
- Microchiroptern bat species including:
 - Eastern Bentwing Bat
 - Greater Broad-nosed bat
 - Eastern Long-eared Bat
 - Eastern False Pipistrelle
 - Yellow-bellied Sheathtail Bat

Potential impacts on these species are examined in Section 4.

3.3 ENDANGERED FAUNA POPULATIONS

There are no listed Endangered Populations of fauna relevant to this site. Endangered Populations of Mitchells Rainforest Snail at Stotts Island, as well as the Long-nosed Potoroo at Cobaki Lakes, are known from the adjacent Tweed Shire.

SECTION 4: IMPACT ASSESSMENT

4.1 POTENTIAL IMPACT ON VEGETATION AND FAUNA HABITATS

Potential development impacts include:

- Loss of habitat potentially relied upon for all or part of the life-cycle of a number of species. Of most concern are the threatened species Koala and Wallum Froglet.
- Fragmentation, increased edge effects and loss of connectivity between vegetation communities and habitat patches.
- Alteration to drainage, hydrology and possibly flooding regime (through excavation or filling).
- Pollution of ground and surface waters from sewage management and/or site uses within a flood-prone landscape.
- Loss or reduction in nectar sources, hollow-bearing trees and (indirectly) insect populations.
- Loss of dense ground cover layer and fallen logs.
- Increased noise and traffic during the day.

4.2 REVISED DEVELOPMENT FOOTPRINT

Impacts will be avoided, minimised and mitigated through the measures listed below, illustrated in Figure 12 and described in detail in Section 6.

- Subdivision re-design to restrict the proposed lot yield to five new allotments.
- Implementation of building envelopes on each lot.
- Detailed survey undertaken with an Ecologist to avoid high conservation value habitat or species.
- Pushing road reserve boundary slightly south to reduce clearing of mature vegetation.
- Removing or realigning the road extension proposed to connect with
- Retention of areas of highest habitat value in Council ownership.
- Replanting of Swamp Sclerophyll Forest to improve connectivity and offset losses.
- Prohibiting night use of the airfield (as currently exists).
- Prohibiting dogs from residing on site.

Table 4.1 details the originally proposed and the revised allotment sizes (following assessment of conservation value) and considers expected habitat loss per lot. Note that these figures assume that the entrance road is constructed; water services provided to each of the five lots proposed for sale and each such lot is cleared and developed. In this way the extent of habitat loss is considered for the entire proposal.

TABLE 4.1
REVISED SUBDIVISION ALLOTMENT DETAILS

Lot Number	Original size (m2)	Revised size (m2)	Building Envelope size (m2)	Estimated habitat loss (m2)		
				<u>EEC</u>	<u>Regrowth</u>	<u>Exotic grassland</u>
1	4159	4159	3045	0	0	3045
2	3927	1890	1595	120	270	460
3	3635	8580	Retained as habitat			
4	3343					
5	3575	750	563	110		
6	1360	1360	Occupied	-	-	-
7	5878	5878	Occupied	-	-	-
8	1806	1806	Occupied	-	-	-
9	1198	1198	Occupied	-	-	-
10	1042	1042	Occupied	-	-	-
11	5136	5136	Occupied	-	-	-
12	10122	3000	1910		280	1930
13	8030	2667	1760	0	315	
Access Road and services (20m wide)				390	750	120
TOTAL				620	1615	5555

4.3 IMPACTS ON THREATENED SPECIES

Flora and Vegetation Communities

TABLE 4.2 LIKELIHOOD OF IMPACT ON THREATENED FLORA and EEC's			
<i>Scientific Name/ Common Name</i>	STATUS TSC Act (EPBC)	HABITAT SYNOPSIS	IMPACT
<i>Arthraxon hispidus</i> Hairy Jointgrass	V (V)	Edges of rainforest and in wet eucalypt forest, often near creeks or swamps	Vegetation clearing -potential loss of disturbed habitat during road construction
<i>Geodorum densiflorum</i> Pink Nodding Orchid	E1	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand	Vegetation clearing -potential loss of disturbed habitat during road construction.
<i>Phaius australis</i> Southern Swamp Orchid	E1 (E)	<i>Melaleuca quinquenervia</i> swamps and in sclerophyll forest, on the coast, at or near sea level	None likely as species not found during detailed survey.
<i>Phaius tancarvilleae</i> Lady Tankerville's Swamp Orchid	E1 (E)	Swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest.	None likely as species not found during detailed survey.
<i>Syzygium hodgkinsoniae</i> Red Lilly Pilly	V (V)	riverine and subtropical rainforest on rich alluvial or basaltic soils	None likely as species not found during detailed survey.
<i>Syzygium moorei</i> Coolamon	V (V)	Subtropical and riverine rainforest at low altitude	None likely as species not found during detailed survey.
<i>Swamp Sclerophyll Forest on Coastal Floodplains</i> EEC	EEC	Close to standing water on soils that are either waterlogged or subject to periodic flooding or inundation	Loss of approx 620m2 of Swamp Sclerophyll Forest.

Fauna

TABLE 4.3
LIKELIHOOD OF IMPACT ON THREATENED FAUNA

Common Name	STATUS TSC Act (EPBC)	HABITAT SYNOPSIS	IMPACT
Koala	V (V)	Forest, woodland with preferred feed trees	Loss of approximately 620m ² of Secondary B koala habitat. No preferred koala food trees (Swamp Mahogany, Forest Red Gum) will be removed.
Wallum Froglet	V	Various wallum habitat	Loss of approximately 620m ² of Swamp Sclerophyll forest on edges. No impact is expected as all areas of preferred habitat will remain undisturbed (Figure 12).
Olongburra Frog	V (V)	Sedge swamps in wallum habitat	No impact. Potential habitat only occurs within drains with permanent standing water. These will remain undisturbed.
White-eared Monarch	V	Forest canopy, rainforest, floodplain forest	Loss of approximately 620m ² of swamp sclerophyll forest. This is not expected to limit use of the site and surrounds by the species given the extent of remaining suitable habitat in close proximity.
Rose-crowned Fruit-dove	V	Mainly rainforest, also floodplain forest	Loss of approximately 20 immature mid-storey rainforest edge species. This is not expected to limit use of the site and surrounds by the species given the extent of remaining suitable habitat in close proximity.
Eastern Grass Owl	V	Sedgelands, tall grasslands, sugar cane	Loss of approximately 5555m ² of exotic grassland. The species was not flushed during extensive walk-through of the site.
Glossy Black Cockatoo	V	Forests and woodlands with <i>Allocasuarina</i> species and hollows for nesting	No impact expected as all <i>Allocasuarina</i> /Casuarina species (only found along Yarum Road where planted by RMS) or hollow-bearing trees will be removed. Hollows are generally of insufficient size for the species within the site.
Grey-headed Flying-fox	V (V)	Forest, woodland, gardens	Loss of approximately 620m ² of Swamp Sclerophyll forest on edges. No camp will be affected, nearest roost is known from Myocum. Loss of forage habitat insignificant given the large forage distances and available habitat within that area. No impact expected.
Common Planigale	V	Diverse habitat, community edges, water access	Loss of approximately 620m ² of Swamp Sclerophyll forest on edges and 1615m ² of Acacia regrowth.
Eastern Bentwing Bat	V	Forest, woodland. Requires caves, stormwater culverts or buildings for roosts.	No impact as no roost site available or affected on site. Minor loss of forage habitat considered insignificant given extent of adjacent habitat.
Greater Broad-nosed bat	V	Open woodland and dry open forest, roost in hollows or under bark.	No impact expected as no loss of hollow-bearing trees and no loss of woodland.
Eastern Long-eared Bat	V	Lowland subtropical	No impact expected as no loss of hollow-

		rainforest and wet and swamp eucalypt forest, roost in hollows or under bark or in hanging palm fronds etc.	bearing trees and very minor loss of forage habitat. Preferred area conserved.
Eastern False Pipistrelle	V	Moist habitats, trees >20m. Roosts in eucalypt hollows, under loose bark on trees or in buildings.	No impact expected as no loss of hollow-bearing trees and very minor loss of forage habitat. Preferred area conserved.
Yellow-bellied Sheathtail Bat	V	Variety of treed and treeless areas, roosts in tree hollows and buildings.	No impact expected as no loss of hollow-bearing trees and very minor loss of forage habitat. Preferred area conserved.

IMPACT SUMMARY

No threatened flora species as listed within the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999* were recorded within the site subject to development. While a number of threatened flora species have been identified as having suitable habitat within the larger site, it is considered that no threatened flora species are likely to be impacted by the proposal such that a viable local population would be placed at risk of extinction. Two species - *Arthraxon hispidus* (Hairy Jointgrass) and *Geodorum densiflorum* (Pink Nodding Orchid) – could occur and have been missed during survey due to the small, creeping nature of Hairy Jointgrass and the habit of Pink Nodding Orchid to arise from underground tubers in summer and/or following disturbance. A second thorough search for these species will occur during stadia survey of impact areas. If found, work will cease until an assessment of significance is undertaken.

Two Endangered Ecological Communities are recognised on site. One of these – *Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, SE Corner and Sydney basin Bioregions* will be impacted through loss of approximately 620m² of disturbed habitat. An assessment of significance for this community follows in this section.

Five threatened fauna species are considered to be present or have suitable habitat present on the site for all components of their lifecycle: the Koala (*Phascolarctus cinereus*), Wallum Froglet (*Crinia tinnula*), Eastern Grass Owl (*Tyto longimembris*), White-eared Monarch (*Carterornis leucotis*) and Common Planigale (*Planigale maculata*). Of these, Wallum Froglet habitat will be retained and conserved (Figure 11) such that no impact is likely and the extent of habitat removal will not affect use of the site by the White-eared Monarch. Assessments of Significance have been undertaken for the remaining three species below.

ASSESSMENTS OF SIGNIFICANCE (TSC Act 1995)

For the purposes of the *Threatened Species Conservation Act 1995*, the following factors must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats. These factors, commonly known as the seven part test, constitute Sec. 5A of the *Environmental Planning and Assessment Act 1979* (as amended) and are addressed below insofar as they relate to threatened flora and fauna species associated with the Tyagarah subdivision.

Flora

1. Swamp Sclerophyll Forest on coastal floodplains EEC

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Response: Swamp Sclerophyll Forest is a listed Community not a threatened species, thus this question is not applicable.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable population of the species is likely to be placed at risk of extinction

Response: An 'endangered population' means a population specified in Schedule 1 Part 2 of the Act. Neither the subdivision site itself, nor immediately adjoining habitat areas are listed as supporting any endangered populations for the purposes of the Act. In fact, there are no endangered flora populations known from Byron Shire.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Response: An endangered ecological community means a community listed in Part 3 of Schedule 1 of the Act. In this regard the NSW Scientific Committee (2007) determined to list *Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, SE Corner and Sydney Basin Bioregions* as an EEC. The proposed subdivision site contains vegetation communities conforming to the geographic and physiognomic characteristics of this community. This EEC will be impacted through loss of 620m² of vegetation for road construction and allotment development.

Given that the vegetation community proposed for removal is already suffering from edge effects (being along the road edge, between the two access roads or at the edge of exotic grassland); does not contain the dense understorey of other parts of the site and does not contain the preferred koala food tree of other parts of the site, as well as the extent of the EEC locally (1301,441m² or over 130ha within 2km of the site) it is considered that the loss will not place the local occurrence of this EEC at risk of extinction, nor will the actions proposed substantially and adversely modify the composition of the community such that its local occurrence is likely to be placed at risk of extinction.

(d) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality

Response: Approximately 620m² of Swamp Sclerophyll Forest will require removal for the development out of some 130 hectares mapped in the local area. Whilst all EEC habitats are important, that proposed for removal is the lowest quality on the site, lacking a developed understorey, tree hollows and with limited species representation. Further fragmentation of habitat will not occur because connectivity will be retained, through conservation and replanting on site. Replacement of lost habitat on a 10:1 area basis will improve connectivity and increase the extent of EEC in the longer term.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Response: The term 'critical habitat' means habitat listed in the Register of Critical Habitat kept by the Director-General of the Department of Environment and Conservation. Neither the proposed development nor adjoining habitat areas are currently listed as critical habitat.

(f) whether the action proposed is consistent with the objectives and actions of a recovery plan or threat abatement plan

Response: There is no approved recovery plans are in place for swamp sclerophyll forest, although the EEC is subject to conservation actions. The proposed activity is not considered to be inconsistent with objectives and actions detailed in these plans.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process

Response: The removal of native vegetation constitutes part of a key threatening process. The extent has been substantially reduced from the original proposal, is confined to poorer quality edge habitat and offsets will increase the amount of the community in the local area in the longer term.

Conclusion

Given consideration of the above factors and the extent of works, it is very unlikely that a significant impact will result for the endangered community Swamp Sclerophyll Forest and therefore the proposed action does not require a Species Impact Statement.

Fauna

2. Koala, Eastern Grass Owl and Common Planigale

Koala

Koalas inhabit forested areas with preferred Eucalypt food trees, also utilising non-Eucalypt species as a food source and roost. Koalas inhabit both wet and dry Eucalypt forest that contains a canopy cover of approximately 10 to 70% (Reed et al. 1991) growing on high nutrient soils. The subject site contains core koala habitat with evidence of past use (previous surveys) and current use through scats found.

Habitat assessment included assessment for Koala usage of the site and all trees within transects were inspected for signs of Koala use. Trees within each quadrat were identified and inspected for

sightings, indicative scratches on the trunk and scats around the base of each tree. As well as the SAT technique and subsequent transects, areas containing Swamp Mahoganies were targeted for inspection whilst on site. Evidence of this species use of the subject site was recorded during survey. The development proposes the retention of all areas of preferred tree species for this species within the site.

Eastern Grass Owl

The Eastern Grass Owl is a medium-sized, ground-dwelling bird (35 cm) with a facial disc typical of the Tyto owls. It is a nocturnal predator of small mammals, insects and birds that inhabits tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. It roosts and nests on the ground by day in a 'form' - a trampled platform in a large tussock - and hunts from early evening by flying low over grassland / heathland sites with suitable prey populations and diving feet first to the ground to catch prey. If disturbed, they burst out of cover, flying low and slowly, before dropping straight down again into cover. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues.

The species is considered a possible occurrence in tall grassland on Lot 1 and parts of Lots 12 and 13. It is also possible amongst closed fernland/sedgeleand under Swamp Sclerophyll Forest at the site; however, none of this area with a dense understorey will be impacted by the proposal.

Threats listed for this species include loss of habitat by grazing, agriculture and development, disturbance and habitat degradation by stock, use of rodenticides and inappropriate fire regimes.

Common Planigale

Planigales are tiny dasyurid marsupial, known for being fierce carnivorous hunters and agile climbers, preying on insects and small vertebrates, some nearly their own size. They inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas, usually close to water. They require dense groundlayer vegetation under which to shelter. Planigales are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. They breed from October to January when the female builds a nest lined with grass, eucalypt leaves or shredded bark. Phillips (2014 *pers comm.*) advises that the most important attribute required for the species is diversity of habitat.

This species could potentially occur in edges, ecotones or Swamp Sclerophyll Forest on site.

Threats to this species are: predation by foxes, dogs, cats and cane toads; clearing, fragmentation, underscrubbing / grazing of habitat; and inappropriate fire regimes.

Assessment of significance

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Response:

Impacts for each of the three species listed above are restricted to clearing of habitat. In all cases, the quantity of habitat removal in comparison to that remaining both on site and immediately adjacent the development is largely inconsequential. No preferred koala food trees will be removed and clearing of understorey is restricted to exotic grassland, non-favoured habitat for the grass-owl and planigale. Thus it is concluded that the life cycles of the threatened species identified above are unlikely to be disrupted such that viable local population(s) will likely be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable population of the species is likely to be placed at risk of extinction

Response: An 'endangered population' means a population specified in Schedule 1 Part 2 of the Act. Neither the development site nor any adjoining habitat areas are listed as supporting any endangered populations for the purposes of the Act.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Response: Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality*

Response:

Koala – loss of 620m² of Secondary B koala habitat. No loss of preferred food tree species.

Grass Owl – loss of 5500m² of exotic (weedy) grassland.

Planigale – as above, plus loss of 1600m² of regrowth habitat.

Aside from disturbance at the proposed road edge and for the five new lots, the remainder of the proposed development will involve conservation of good quality habitat and improvement of linkages, or else maintenance of the status quo (in the case of lots already occupied by business or community uses). Thus, further fragmentation of habitat will not occur. The comparatively small areas of non-preferred habitat proposed to be removed are unlikely to be important for the long-term survival of these species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Response: The term 'critical habitat' means habitat listed in the Register of Critical Habitat kept by the Director-General of the Department of Environment and Conservation. Neither the proposed development nor adjoining habitat areas are currently listed as critical habitat.

(f) whether the action proposed is consistent with the objectives and actions of a recovery plan or threat abatement plan

Response: Of the three threatened fauna species being considered for the purpose of this subdivision, only the koala is the subject of an approved recovery plan (DECC 2008). Relevant objectives proposed by this plan include retention and planting of preferred koala food trees, development of appropriate road risk management strategies to reduce the potential for motor vehicle strike and reducing contact with domestic dogs.

A variety of priority actions for remaining species deemed to be at medium or high risk by this assessment have been promoted by DECC, none of which infer non-conformity with the proposed action in this instance.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result

in the operation of, or increase the impact of a key threatening process.

Response: The actions proposed in this instance constitute part of a key threatening process, being removal of native vegetation. As previously discussed, no essential habitat component will be removed that is not present in high quantity on the site or in the immediate surrounds. Once offsets are implemented, actions are not likely to result in the operation of, or increase the impact of any key threatening processes.

Conclusion

Given consideration of the above factors and the extent of works, it is very unlikely that a significant impact will result for the Koala, Eastern Grass Owl or Common Planigale and therefore the proposed action does not require a Species Impact Statement.

ASSESSMENTS UNDER EPBC ACT 1999

Consideration of potential development impacts in accord with the administrative guidelines of the Environment Protection and Biodiversity Conservation Act 1999 (if relevant) are addressed below.

Flora

Of the seven threatened flora species considered to be possible occurrences on the site, six are listed as Endangered or Vulnerable for purposes of the EPBC Act. Individuals of these species are at risk only in the event that vegetation clearing results in the removal of the plant and/or its habitat, the probability of which is considered to be low. The criteria by which these species are required to be assessed are detailed in Table 4.4.

Considerations derived from the EPBC Act Policy Statement 1.1 (2006).

U=unknown, P=possible, N=no.

TABLE 4.4
FLORA CONSIDERATIONS UNDER THE EPBC ACT

	Assessment
Will development lead to a long-term decrease in the size of a population*?	N
Will development reduce the area of occupancy of the species?	N
Will development fragment an existing population* into two or more populations?	N
Will development adversely affect habitat critical to the survival of the species?	N
Will development disrupt the breeding cycle of a population*?	N
Will development modify, destroy, isolate or decrease the availability or quality of habitat to such an extent that the species is likely to decline?	N
Will development result in invasive species that are harmful to a species becoming established in the species' habitat?	N
Will development introduce disease that may cause the species to decline?	N
Will development interfere substantially with the recovery of the species?	N

Fauna

Of the three threatened fauna species deemed to be potentially at risk from the proposal, the Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) is the only species listed under the EPBC Act. Draft referral guidelines have been developed for these koala populations. Referral hinges on whether habitat critical to the survival of the koala will be impacted. The definition is reproduced below.

Habitat critical to the survival of the koala: Koala habitat that is considered to be important for the species' long-term survival and recovery. An impact area that scores five or more using the habitat assessment tool for the koala in Table 3 of this guideline contains habitat critical to the survival.

Consideration of the habitat assessment tool gives a rating of six for the overall site and surrounds, which are considered part of “habitat critical to the survival of the koala”. However, when the criteria are applied to the impact area only, the resulting score of 4 determines that the habitat affected is not critical to the survival of the local population. Consideration of the significant impact guidelines under this act is contained in table 4.5.

Considerations derived from the EPBC Act Policy Statement 1.1 (2006).

U=unknown, P=possible, N=no.

TABLE 4.5
FAUNA CONSIDERATIONS UNDER THE EPBC ACT

Considerations under the EPBC Act	Assessment
Will development lead to a long-term decrease in the size of a population?	N
Will development reduce the area of occupancy of the species?	N
Will development fragment an existing population into two or more populations?	N
Will development adversely affect habitat critical to the survival of the species?	N
Will development disrupt the breeding cycle of a population?	N
Will development modify, destroy, isolate or decrease the availability or quality of habitat to such an extent that the species is likely to decline?	N
Will development result in invasive species that are harmful to a species becoming established in the species' habitat?	N
Will development introduce disease that may cause the species to decline?	N
Will development interfere substantially with the recovery of the species?	N

Conclusion

For the purposes of the Environment Protection and Biodiversity Conservation Act 1999, it is concluded that development for the purpose of creating a subdivision, re-constructing a road and providing five allotments suitable for sale is not likely to significantly affect threatened species, populations or ecological communities, subject to the mitigation measures of Section 6 becoming conditions of consent. As a consequence of this conclusion the development does not require referral of the matter to the Federal Environment Minister for approval.

SECTION 5: LEGISLATIVE PROVISIONS

Table 5.1 (below) considers the proposed development against those parts of the legislation that relate to ecological matters.

TABLE 5.1 RELEVANT LEGISLATIVE PROVISIONS		
Legislation	Section(s)/ Provisions	Assessment
Environmental Protection & Biodiversity Conservation Act (1999)	CI 18, 18A & 19: Matters of NES – threatened species and Clause 67, 67A & 68: Environmental assessment & approvals – referral to Dept of Environment	Matters of National Environmental Significance (NES) on the site include the nationally threatened species Koala (<i>Phascolartus cinereus (combined populations of Qld, NSW and the ACT)</i>). Other listed species potentially occurring on the site were considered against habitat requirements and impacts and were discounted for referral. Similarly migratory species were not considered to be significantly impacted by the proposal. 1. <u>Koala</u> – Assessment against Significant Impact Guidelines and specific Koala Referral Guidelines indicates Commonwealth referral for the Koala unlikely to be required as clearing of preferred or critical habitat is not being undertaken.
Environmental Planning & Assessment Act (1979)	Section 5A: (significant effect on threatened species, populations or ecological communities, or their habitats)	Two endangered ecological communities and four threatened fauna species have been recorded from the site. It is considered that changes to subdivision design, retention of important habitat and koala food trees and shifting of the road reserve slightly south is sufficient to be satisfied that the proposal is unlikely to have a significant effect. Assessments of Significance were undertaken for three species and one community.
Threatened Species Conservation Act 1995	Section (94) & Schedules 1, 1A, 2 and 3: Listed species, population & communities	Investigation into the presence of threatened species, populations and ecological communities (and key threatening processes) has been undertaken. See above and Section 4.
Native Vegetation Act 2003	Clause 12: Clearing requiring approval	The Act applies to rural land and generally requires dual consent where vegetation clearing is proposed. Clearing is proposed for a development rather than a rural use and is mostly non-protected regrowth or exotic grassland; therefore no separate consent is required.
Fisheries Management Act 1994	Clause 201: Fisheries Permit	Not applicable – Fisheries permit not required.
Water Management Act 2000	Clause 91: Activity approvals	A controlled activity approval is not likely to be required for the proposal as no dewatering or stream bank work is proposed.
Rural Fires Act	S100B	Subdivision requires consideration of the Planning for Bushfire Protection Guidelines. Site vegetation communities are mapped as Vegetation Category 1 with developable areas mapped as bushfire Buffer. Asset protection zones will be provided within the area already assessed for clearing. Future landscaping will need to conform to inner protection zone requirements (App. 5 of PfBP).
Legislation	Section(s)/	Assessment

	Provisions	
SEPP 44	Clauses 7-11: Development control of Koala habitat	The site represents 'potential' and 'core' Koala habitat, which may not be well occupied at the moment due to impacts elsewhere (as recorded from Bluesfest surveys and monitoring). The site area is included within the draft Byron Coast CKPoM which has been exhibited and amended following submissions. Considering the provisions of this plan, the area is within a Koala Management Precinct (KMP), being part of the Tyagarah/Myocum precinct. An assessment of koala activity on the site has resulted in a 'low' result for the SW corner habitat and a 'high' reading for the NE corner, although all scats viewed were old. In accordance with the CKPoM, development within a KMP should comply with all of the provisions of Section 6 of the plan. The matter is discussed further below.
Draft Byron Coast Comprehensive Koala Plan of Management (KPoM), 2013 (formulated under SEPP 44)	Section 7: Development Assessment & Control	Consideration of the assessment pathway shown in Figure 10 of this document results in the development being regarded as 'large development', requiring a Vegetation Assessment Report. Section 3 of this report complies with this provision and indicates the presence of 'preferred koala habitat' as defined in the CKPoM. The site is also within the the Tyagarah/Myocum KMP and thus must be consistent with the Development Standards of section 7.4. Section 7.4.2 <i>Land within a KMP or verified as core koala habitat</i> states that "approval for clearing of Preferred Koala Food Trees will only be granted if Council is satisfied any clearing does not include trees that a KAAR has demonstrated are used by koalas." These provisions require compensation for preferred koala habitat (PKH) proposed to be removed. As PKH includes Secondary B habitat (which is proposed for removal here), the compensation requirements apply. This and other development requirements are detailed in Table 5.2 below.
SEPP 71 Coastal Protection	Clause 8: Matters for consideration	The site is within the coastal zone and complies with the definition of "sensitive coastal location" under this SEPP. Clause 8 matters are discussed below. a) <i>Aims of this policy</i>: Aims include at 2(g): "to protect and preserve native coastal vegetation" – the development complies with this aim by limiting habitat removal, retaining important diverse communities, and proposing offsets to increase the total habitat in the longer term. d) <i>The suitability of development given its type, location and design and its relationship with the surrounding area</i>: Subdivision design has been modified to provide a minor development with little impact in the context of the site and surrounds. Main habitat areas will be conserved and use will be diurnal only with no dogs residing on site. Thus the modified development is considered suitable for the site. g) <i>measures to conserve animals (within the meaning of the Threatened Species Conservation Act 1995) and plants (within the meaning of that Act), and their habitats</i>: The development proposes methods to protect habitat and water quality, and to prohibit dogs, avoid nocturnal activity and improve connectivity.
Byron LEP 2014	Clause 1.2 Aims	These clauses provide for the protection of the environment, protection of biodiversity and for Ecologically Sustainable development. Substantial reduction of proposed clearing and site-

		specific management plans will enable the proposal to conform with ESD principles.
Byron LEP 2014	Clause 5.5 – Development within the coastal zone	The site lies just within the mapped coastal zone, thus this clause is applicable.
Byron LEP 2014	Clause 5.9: Preservation of trees	Aims to preserve habitat and requires development consent for clearing of native vegetation, which is sought.
Byron LEP 2014	Clause 63: Acid Sulfate Soils	This clause applies to the management of Acid Sulfate Soils. The site is mapped as Class 3 land which requires careful consideration of works more than 1m below the surface. No such works are proposed as part of the subject application, with the road more likely to be built up and future water main placed higher than 1m below natural ground level.
Byron LEP 2014	Part 2 - Zones	The bulk of the site is zoned RU2 Rural Landscape. Surrounding areas intended to be mapped under LEP 2014 as Environmental Protection zones have been deferred from the current LEP. Deferred areas relate to proposed Lots 1 to 4 and the SW part of Lot 13 (not included within revised Lot 13). Deferral means these areas must be considered as zoned under LEP 1988, which is 1(a) Rural, hatched. The hatching overlay requires council to consider suitability in light of potential constraints on the land including flooding, landslip, bushfire hazard, soil erosion and the like. The site is subject to flooding and bushfire hazard and these matters will be considered by others.
Byron LEP1998	Clause 2A(2) – Byron Biodiversity Conservation Strategy 2004 (BCS)	Habitat removal is proposed. No net loss provisions have been addressed through compensation requirements set out in the draft Byron Coast CKPoM.
Byron Biodiversity Conservation Strategy 2004 (BCS)	Clause 2A(2) –	The BCS includes a No Net Loss Vegetation Policy that provides for compensatory plantings to offset loss of vegetation. Vegetation loss includes 620m ² of Swamp Sclerophyll Forest EEC and replacement habitat is proposed at a ratio of 9:1 in area. This equates to 0.55ha of replanting/ regeneration.
Byron DCP 2014	Chapter B2: Tree preservation	Aims to encourage the retention of trees and the planting of species endemic to the local area. No trees on the significant tree register are proposed for removal as part of the DA. Restoration works are proposed, thus an overall improvement in native vegetation extent is expected in the longer term.
Byron DCP 2014	Chapter B9 – Landscaping	A Landscape Plan complying with this chapter will be submitted with the application for a construction certificate. It is likely that all landscaping will be required to comply with the provisions of Appendix 5 of the RFS PFBP Guidelines.
NSW Wetlands Policy	Guiding Principles:	Principles include: recognition of wetlands as valued places and land practices should maintain or improve wetland values. Given that the proposal has no removal of permanent wetlands or drawing of water from groundwater; that construction activities potentially generating sediment will be subject to an erosion and sediment control plan and any future on-site sewage management would require a management plan, the development complies with the intent of the policy.

Detailed assessment against the provisions of the draft Byron Coast Comprehensive Koala Plan of Management is provided below.

TABLE 5.2 ASSESSMENT AGAINST DRAFT BYRON COAST COMPREHENSIVE KOALA PLAN OF MANAGEMENT DEVELOPMENT PROVISIONS	
Section(s)/ Provisions	Assessment
<u>Section 7.3.2 ii a) to d)</u> - Standard Vegetation Assessment Report	Section 2 describes floristic communities; Appendix 1 lists plant species, Figure 9 maps plant communities. Section 2 and 3 recognise preferred koala food trees and PKH within the development boundaries.
<u>Section 7.3.2 ii e) to g)</u> - total area of preferred koala habitat proposed to be cleared	Secondary B habitat (swamp sclerophyll forest) proposed for removal = approximately 620m ² . Stadia-metric survey will be undertaken (with large and preferred trees flagged) but Figure 12 indicates areas proposed for clearing, large trees and proposed compensation areas.
<u>Section 7.3.3</u> – Identification of core koala habitat - RG-bSAT survey/KAAR	SAT survey was randomised but not grid-based given the small size and L-shape of the development area (Figure 8), although the resulting survey occurred at approximately 150m intervals as recommended by the technique. Koala activity levels recorded were 17% for the SW and 27% for the NE survey site. Both areas have an activity level of 9% or greater and thus are regarded as <i>core koala habitat</i> in line with the plan.
<u>Section 7.4.1</u> - Land with PKFT or PKH – retention of Koala habitat - avoidance, minimisation and mitigation,	Removal and/ or impact on Preferred Koala Food Trees has been avoided to the maximum extent possible through substantial modification of the subdivision design as discussed. Stadia survey has yet to be undertaken. Fragmentation will not increase due to design changes enabling the drainage line and highest value habitat to be conserved. Consistency with AS 4970-2009 (Protection of Trees on Development Sites) will be shown following stadia survey.
– maintaining koala corridors	Figure 12 indicates improvement in connectivity through additional planting on the eastern edge of Lot 12.
- protection of koalas from disturbance	Ecologist to undertake pre-clearing survey on each day that tree removal is proposed. Work to cease if koala is found within 25m, until koala has moved on of its own accord.
- bushfire asset protection zones	APZs are to be included within building envelopes illustrated in Figure 11.
<u>Section 7.4.2</u> – Land within KMP	
- retention of PKH	Additional targeted SAT survey has been undertaken for trees within proposed clearing areas – no use of these trees is indicated.
- protection of koalas from disturbance	See above
- swimming pools	not applicable – no swimming pools proposed
- fencing	not applicable – no fencing proposed
- road design	Road will be signposted at 40km per hour and a raised speed hump will be placed at the corridor connection to be planted on the eastern edge of Lot 12. The short length of road prohibits speed build up. As the airfield is not used at night, there is likely to be very little traffic on the new road after dark (when koalas are most likely to move on the ground), and in any case well less than 1500 cars per day. The flood-prone nature of the site likely prohibits

	installation of a culvert (and associated fencing), although this will be investigated (see Mitigation section). The originally proposed additional connecting lane at the cul-de-sac head will not be constructed, rather the current narrow gravel access will remain gated.
<u>Section 7.4.3 Subdivision layout</u>	
- retention and protection of koala habitat	Large trees and hollow-bearing trees have been located by GPS and will be retained, with no PKFT requiring removal. Land within the originally proposed Lots 3 and 4, as well as part of Lot 2 will be rezoned for environmental protection under the Local Environment Plan once deferred matters are signed off by state government. A Koala Habitat Rehabilitation Plan consistent with the requirements of Part 9 of the CKPoM will be prepared following stadia survey.
- layout and design	Corridor planting on Lot 12, as well as offsets on adjacent land, will enhance connectivity and allow free and safe movement of koalas between areas of Preferred Koala Habitat or Preferred Koala Food Trees.
- building envelopes	Building envelopes are illustrated in Figure 11 and will be cemented through plan approval and stamping.
- domestic dogs	Although this application is not 'residential' by nature, the intent to prohibit dogs in Koala areas is clear and the development conforms. A restriction on title will apply to all new lots which prohibits dogs residing on site. "No dogs" signage shall be installed at all entry points.
- education and awareness	Interpretive signage communicating the importance of the site for koalas will be installed at the large lot to be retained in Council ownership and zoned for environmental protection.
<u>Section 8.1 - Compensation</u>	
- Prepare KHRP	A Koala habitat rehabilitation plan will be prepared once stadia survey is completed and offset site(s) are finalised. Sites a and b in particular are ideally located to infill gaps and improve connectivity. Each of the listed matters will be detailed within the plan. Compensation works will commence prior to the removal of PKH.
<u>Appendix 3: Compensation multiplier</u>	Using Table 2 (area multiplier): Loss of 620m ² (0.062ha) of Secondary B Koala Habitat within a KMP requires multiplying the area lost X 9 to obtain the offset area. In this case the resultant area is 5580m ² or 0.558ha. Suitable locations (subject to negotiations) are illustrated in Figure 13.

SECTION 5: MITIGATION MEASURES

Mitigation and amelioration measures undertaken/ to be undertaken are:

1. Re-design of the original subdivision layout to reduce lot numbers, avoid High Conservation Value habitat and maintain connectivity with surrounding habitat. This included:
 - reducing the number of new lots available for sale from 7 to 5,
 - substantially reducing the size of four of these lots,
 - placing building envelopes upon all unoccupied lots,
 - conserving highest value habitat in a single lot to remain in Council ownership (expected to be zoned for environmental protection as currently deferred in LEP 2014),
 - reducing the width of the road reserve (from 20m to 15m),
 - moving the proposed road alignment slightly south (see Table 4.1 and Figures 11 and 12) and
 - removing the road extension connecting the cul-de-sac head with the gravel road leading to the pistol club.
2. Site survey and pegging in conjunction with Council's Ecologist to define and avoid (wherever possible) individual ecological constraints, including trees >250mm diameter at breast height (dbh) and hollow-bearing trees. Further searches for Hairy Joint-grass and Pink Nodding Orchid will occur for all impact areas during this process. If found (or if any further threatened species found), work will cease until assessments of significance are undertaken.
3. Stadia survey and protection on title of remnant trees with a diameter at breast height of 250mm or greater and any hollow-bearing trees.
4. Allocation of building envelopes on all new allotments.
5. Restriction on use of airstrip to diurnal use only (as currently occurs).
6. Restriction on use of the land to prevent dogs residing on site.
7. Careful consideration of road earthworks and placement of services in the road corridor.
8. Allocation of resources to consider alternate Council/Crown land available for pistol, rifle and clay target shooters' clubs to an area of lower ecological sensitivity.
9. Negotiation to commence with the Crown as landowners, the Committee of the local Pistol and Rifle Club and with the Tyagarah Clay Target Shooters Club to relocate to a site of lower ecological sensitivity.
10. Negotiation to commence with Roads and Maritime Services in relation to potential for replanting part of land owned by RMS to the immediate north of the development site.
11. Offset site(s) to be secured and site specific Koala Habitat Restoration Plan to be prepared to provide a minimum of 0.55ha of replanting.
12. Provision of offset planting and/or rehabilitation (as appropriate to the final offset site(s)) at a ratio of (at least) 10 to 1 (6200m²) to replace lost habitat. Offset site preferences in order of preference (based on perceived gain for local koala population):
 - a. Crown land occupied by the local pistol and rifle club. Filling in this site with trees dominated by Swamp Mahoganies will improve the situation of the local koala population

both by removing a potential threat to their safety and by reducing avoidance of the area due to sudden loud noise emissions.

- b. Crown land occupied by the clay target shooters clubs
- c. RMS-owned land immediately north of Lots 1, adjacent to the development site.
- d. Other local site to be negotiated.

SECTION 6: CONCLUSION

Based on the field survey and assessment information provided in this report it is concluded that:

In relation to the *Threatened Species Conservation Act* (1995)

i) No threatened flora species or endangered populations were observed within the subject site. The disturbed nature and limited diversity of parts of the site proposed for development, coupled with the small development footprint, mean that threatened flora species are unlikely to be impacted by the proposal.

iii) Two endangered ecological communities were observed within the subject site: Swamp Sclerophyll Forest on coastal floodplains and Sub-tropical coastal floodplain forest.

ii) Five threatened fauna species as listed within the TSC Act 1995: the Koala, Wallum Froglet, Eastern Grass Owl, White-eared Monarch and Common Planigale are either known or expected to occur on site and were considered to have suitable habitat for all or part of their lifecycle present on site. A number of other fauna species were considered to have suitable forage habitat on the site but limited roost potential, often due to the lack and small size of hollows.

In relation to the *Environment Protection and Biodiversity Conservation Act* (1999)

i) No other threatened flora or fauna species, endangered population, endangered ecological communities or significant migratory species were observed within the subject site, nor are any considered likely to suffer a significant impact from this proposal. It is considered that a referral of this project to the Department of Environment is not required.

In conclusion:

The subdivision layout has been significantly modified from the original proposal in order to retain important habitat. The revised lot layout retains all areas of highest conservation significance in Council ownership. Due to the re-design, is considered the reduced development footprint will impact primarily cleared land and regrowth vegetation of lower conservation significance. Given these changes:

- A significant impact on threatened species, populations and ecological communities is considered unlikely and a Species Impact Statement is not required.
- Referral under the EPBC Act is not required.
- Additional management plans will be required for the development to proceed to occupation; including on-site sewerage, stormwater and hydrology, threatened species, erosion and sediment control, acid sulphate soil management and flood and bushfire risk.
- Offsets are required for loss of habitat. It is proposed that restoration works be undertaken within land remaining in Council ownership (lots 3, 4 and part lot 2). and that the feasibility of an ecological (cool) burn be investigated to promote retention of important Eucalypt communities and koala habitat.

REFERENCES

ADD IN – Blues reports Blackwood report

Previous Tyagarah studies – Fitzgerald and McAlpin

Auld, B.A. & Medd, R.W. 1987, *Weeds - an illustrated botanical guide to the weeds of Australia*, Inkata Press: Sydney.

Bale, C.L. (2003) *Eucalypts and Angophoras of the North Coast of New South Wales – a key to the indigenous species*. Department of Botany, University of New England, UNE Printery: Armidale

Briggs, J.D., and Leigh, J.H. 1995. *Rare or Threatened Australian Plants*. CSIRO Australia, Collingwood.

Churchill, S. 1998, *Australian Bats*. New Holland, Sydney.

Cogger, H. G. 1992, *Reptiles and Amphibians of Australia*. 4th Ed. Reed Books, Sydney.

Cropper, S.C. (1993) *Management of Endangered Plants*. CSIRO Australia, Melbourne

Debus, S. J. J. S. 1998, *The Birds of Prey of Australia: a field guide*. Oxford, Sydney.

Dickman, C. 1991, Use of trees by ground-dwelling mammals: implications for management, pp. 125 - 136 in *Conservation of Australia's Forest Fauna*, Ed. Lunney, D. Royal Zoological Society of NSW and Surrey Beatty and Sons, Mosman.

Department of Environment and Climate Change, 2010. Threatened Species Website. <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx>. Accessed August 2014.

Department of Environment and Conservation, 2003. Key Habitats and Wildlife Corridors in North East New South Wales. <http://maps.nationalparks.nsw.gov.au/keyhabs/default.htm>

Department of Environment and Conservation, 2004. *Threatened Biodiversity Survey and Assessment. Guidelines for Developments and Activities. Working Draft*. NSW Department of Environment and Conservation, Hurstville, NSW. Accessed September 2010.

Department of Environment and Conservation NSW, 2008. Approved Recovery Plan for the Koala *Phascolarctos cinereus*. DECC, Hurstville.

Department of Environment, Climate Change and Water NSW 2009, *Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region*, Department of Environment, Climate Change and Water NSW, Sydney.

Department of Environment and Conservation NSW, 2006. Approved Recovery Plan for the Large Forest Owls. DECC, Hurstville.

Department of Environment and Conservation NSW, 2003. Approved Recovery Plan for the Yellow-bellied Glider (*Petaurus australis*). DECC, Hurstville.

Department of Environment and Heritage. 2006. *EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance*. Australian Government Department of Environment and Heritage.

Department of Environment, 2014 *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Accessed September 2010.

Elliott, M., 2008. *Grasses of Subtropical Eastern Australia: An introductory field guide to common grasses— native and introduced*. Nullum Publications, Murwillumbah.

Floyd, A.G. 1989. *Rainforest Trees of Mainland South-eastern Australia*. Inkata Press, Sydney.

Hager, T. C. & Benson, J. S. 1994, Review of the conservation status of vegetation communities in New South Wales. *Part 3 Assessment of the conservation status of forest plant communities in north-eastern NSW*. Australian Heritage Commission, Canberra.

Harden, G.J. (ed) 2000. *Flora of New South Wales Volume 1*. Royal Botanic Gardens and New South Wales University, Sydney

Harden, G.J. (ed) 2002. *Flora of New South Wales. Volume 2*. Royal Botanic Gardens and New South Wales University, Sydney.

Harden, G.J. (ed) 1992. *Flora of New South Wales Volume 3*. Royal Botanic Gardens and New South Wales University, Sydney

Harden, G.J. (ed) 1993. *Flora of New South Wales. Volume 4*. Royal Botanic Gardens and New South Wales University, Sydney.

Harden, G.J. and Murray, L.J. (eds) 2000. *Flora of New South Wales*. Supplement to Volume 1. Royal Botanic Gardens and New South Wales University, Sydney

Hoye, G. A. & Richards, G. C. 1995, Greater Broad-nosed Bat. pp. 527 - 528 in *The Mammals of Australia* by Strahan, R. (ed). Australian Museum and Reed Books, Sydney.

Leiper, G., Glazebrook, J. Cox, D. & Rathie, K., 2009. *Mangroves to Mountains: A field guide to the native plant of south-east Queensland*. Society for Growing Australian Plants, Browns Plains, Qld.

Lunney D., Barker J., Leary T., Priddel D., O'Connor P. and Wheeler R. 1995, Roost Selection by the North Queensland Long-eared Bat *Nyctophilus bifax* (Thomas 1915) in Littoral Rainforest on the North Coast of New South Wales, Australian Journal of Ecology.

Martin, R. W. & Handasyde, K. A. 1995, Koala. pp. 196 - 198 in *The Mammals of Australia* by Strahan, R. (Ed). Australian Museum and Reed Books, Sydney.

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. 1990. *Australian Soil and Land Survey Field Handbook, 2nd Edition*. Inkata Press, Sydney.

NPWS, 2002a. *Threatened Species of the Upper North Coast of NSW: Fauna*. NSW National Parks and Wildlife Service, Northern Directorate, Coffs Harbour

NPWS 2002b *Threatened Species of the Upper North Coast of NSW: Flora*. NSW National Parks and Wildlife Service, Northern Directorate, Coffs Harbour.

NSW Department of Environment and Conservation. 2004. *Threatened biodiversity and assessment: guidelines for developments and activities (working draft)*. New South Wales Department of Environment and Conservation, Hurstville, NSW.

NSW National Parks and Wildlife Service 2002. *Threatened Species of the Upper North Coast of New South Wales – Flora*. NSW National Parks and Wildlife Service Northern Directorate, Coffs Harbour.

NSW Scientific Committee 1999. Endangered ecological community listings. <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/endangered+ecological+community+listing>

Phillips, S. and Callaghan, J. 1995. The Spot Assessment Technique for Determining the Significance of Habitat Utilisation by Koalas. Australian Koala Foundation, Brisbane, Queensland.

Pizzey, G. & Knight, F. 1997. Field Guide to the Birds of Australia. Angus & Robertson, Sydney.

RACAC. 1996. Regional Report of Upper North-east New South Wales. Volume 4 - Biodiversity Attributes. Report by the Resource and Conservation Assessment Council and the National Resources Audit Council, Sydney.

Reader's Digest 1997. Complete Book of Australian Birds; Reader's Digest, Sydney

Reed, P. & Lunney, D. 1988, Habitat loss: the key problem for the long-term survival of Koalas in New South Wales. pp. 9 - 31 in Koala Summit - managing Koalas in New South Wales. Ed. Lunney, D., Urquhart, C. A. & Reed, P., NSW National Parks and Wildlife Service, Hurstville.

Robinson, M. 1998. *A Field Guide to Frogs of Australia*. New Holland Publishers (Australia) Pty Ltd.

Sheringham, P. & Westaway, J. 1995. Significant Vascular Plants of Upper North East of New South Wales. A report by the NSW National Parks and Wildlife Service for the Natural Resource Audit Council.

Simpson, K. & Day, N. 1996. Field Guide to the Birds of Australia. Penguin Books, Ringwood, Victoria.

Stanger, M., Clayton, M., Schodde, R., Wombey, J. and Mason, I. 1998, CSIRO List of Australian Vertebrates – A Reference with Conservation Status; CSIRO Publishing, Melbourne.

Strahan, R. 1995, The Mammals of Australia. Reed Books and Australian Museum, Sydney.

Van Dyck, S. and Strahan, R. (Eds.) 2008. *The Mammals of Australia*. Reed New Holland, Sydney.

Watsford, P. (2007) *Plants of the Forest Floor: a guide to small native plants of subtropical eastern Australia*. Nullum Publications, Murwillumbah.

Williams, J.B. (2003) *New England Eucalypts – a key to the indigenous species*. Department of Botany, University of New England, UNE Printery: Armidale

FIGURES



Figure 1: Site location

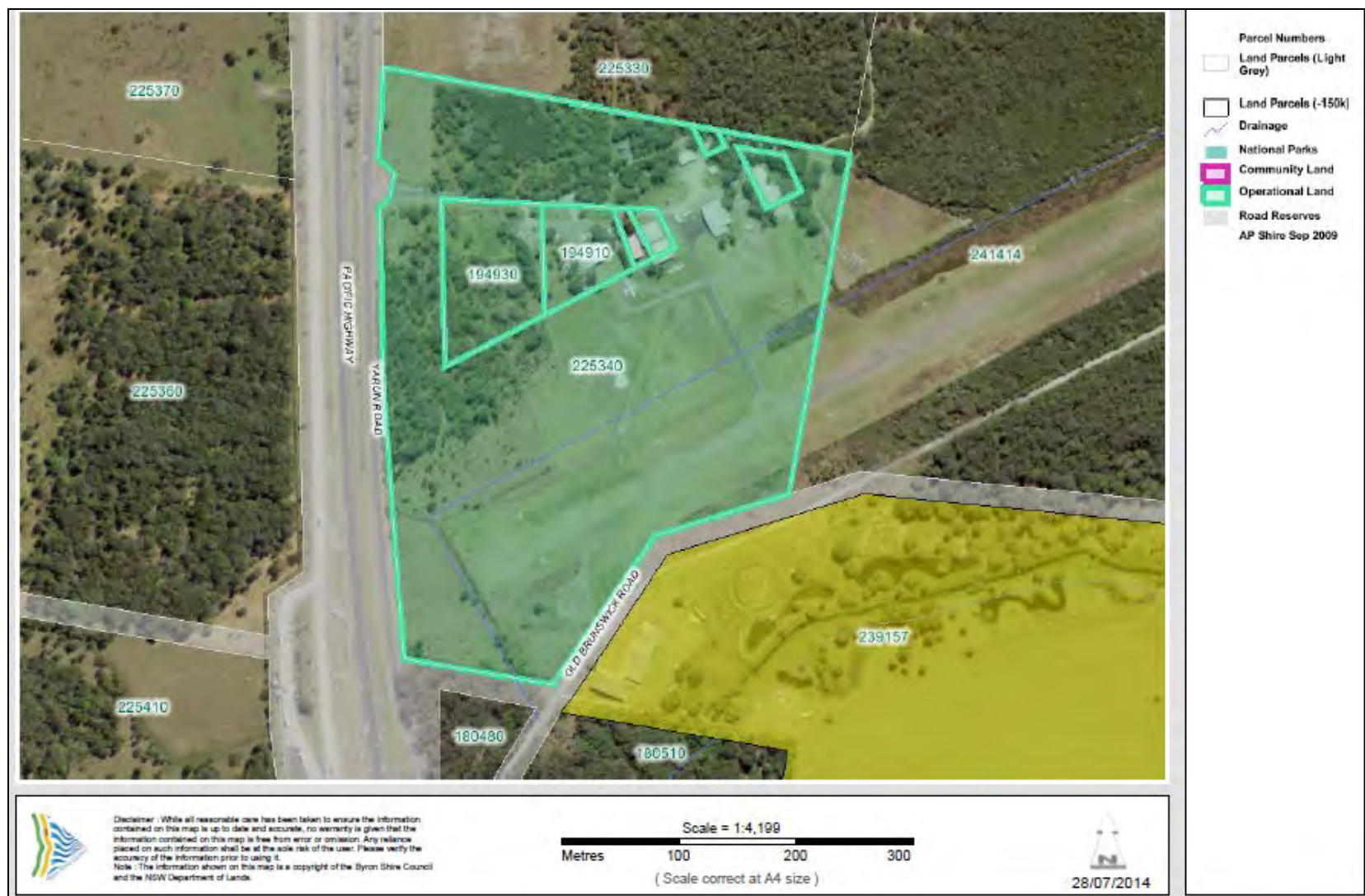


Figure 2: Location of 7 existing lots shaded light green



Figure 3: Proposed subdivision and boundary adjustments for 14 lots

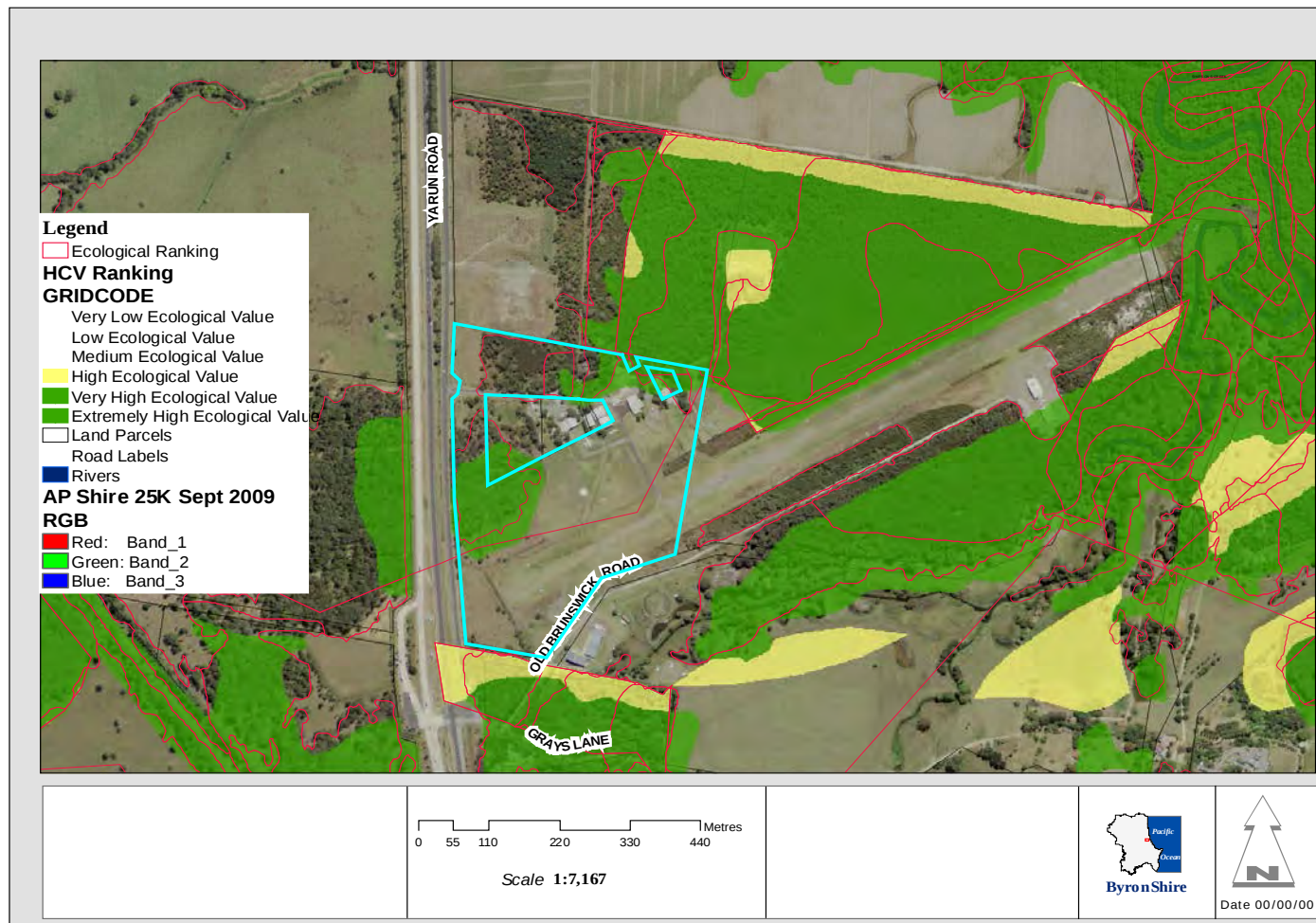


Figure 4: HCVmapping of site and surrounds (BSC)

Mapped High Conservation Value (HCV) vegetation is illustrated yellow (high) and green (very high-extremely high). In fact, all the vegetation on the subject site is recognised as HCV, being part of an Endangered Ecological Community.

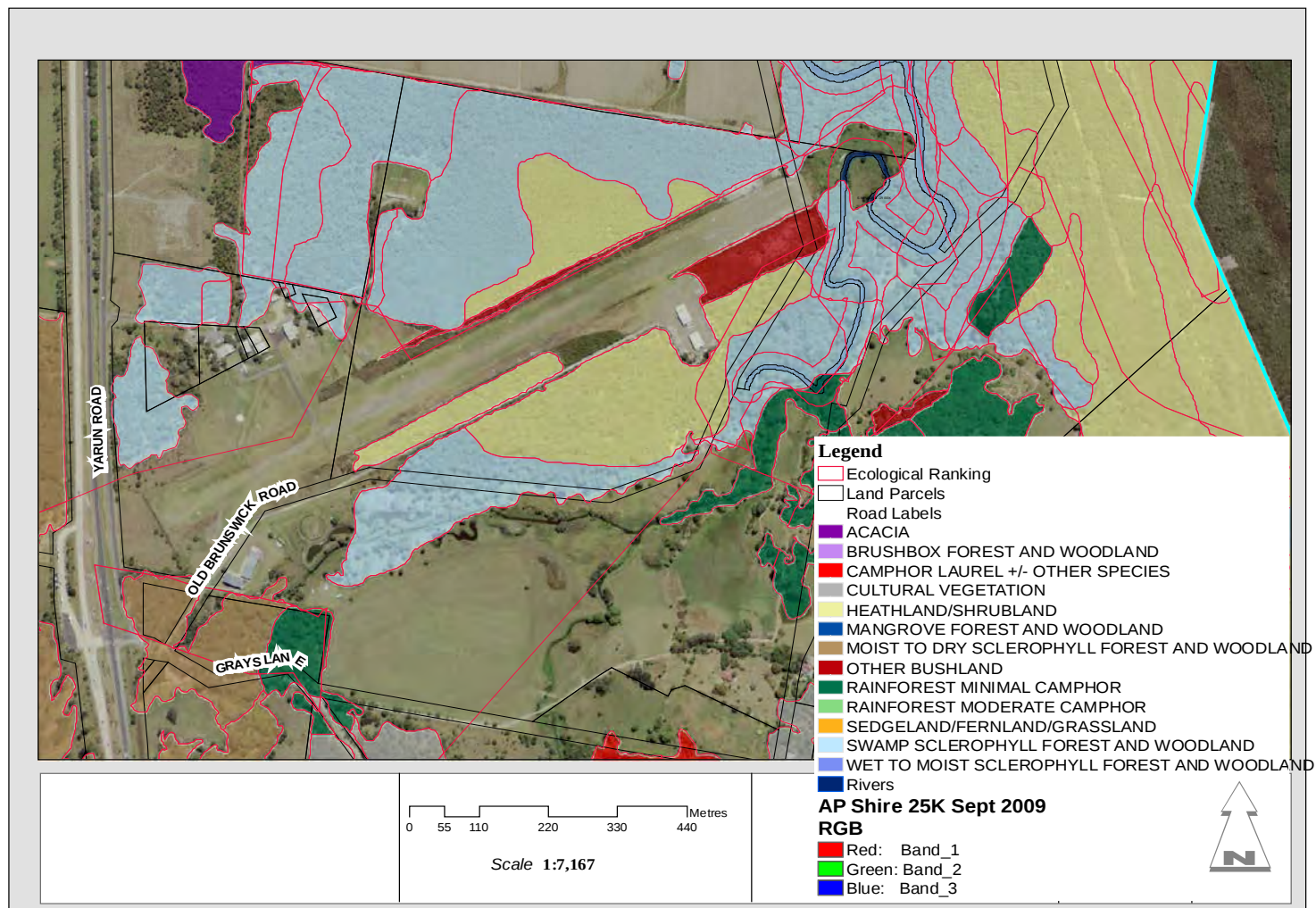


Figure 5: Byron GIS mapping of site vegetation and surrounds (BSC)

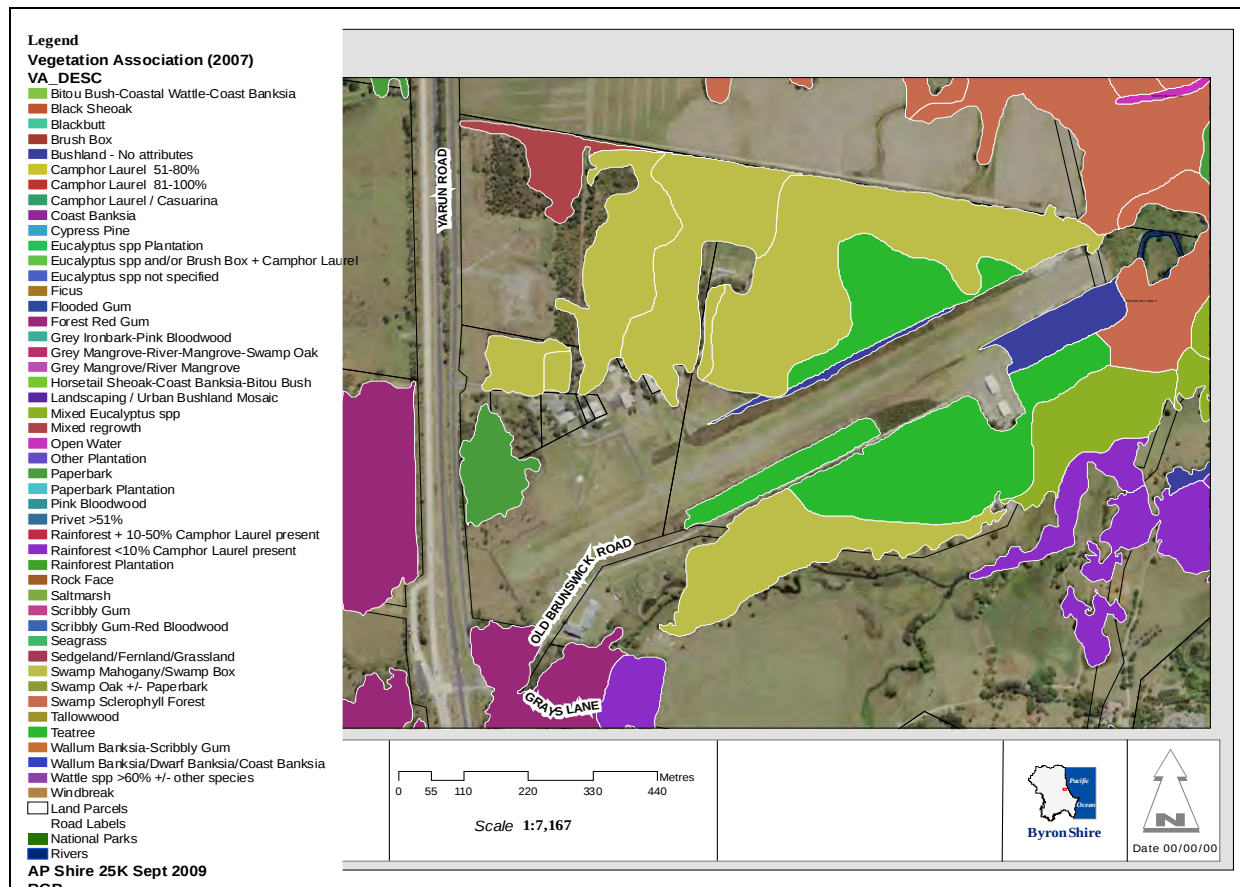


Figure 6: Byron vegetation association mapping (BSC)
 Maps the majority of the site as Swamp Mahogany/Swamp Box and Paperbark.

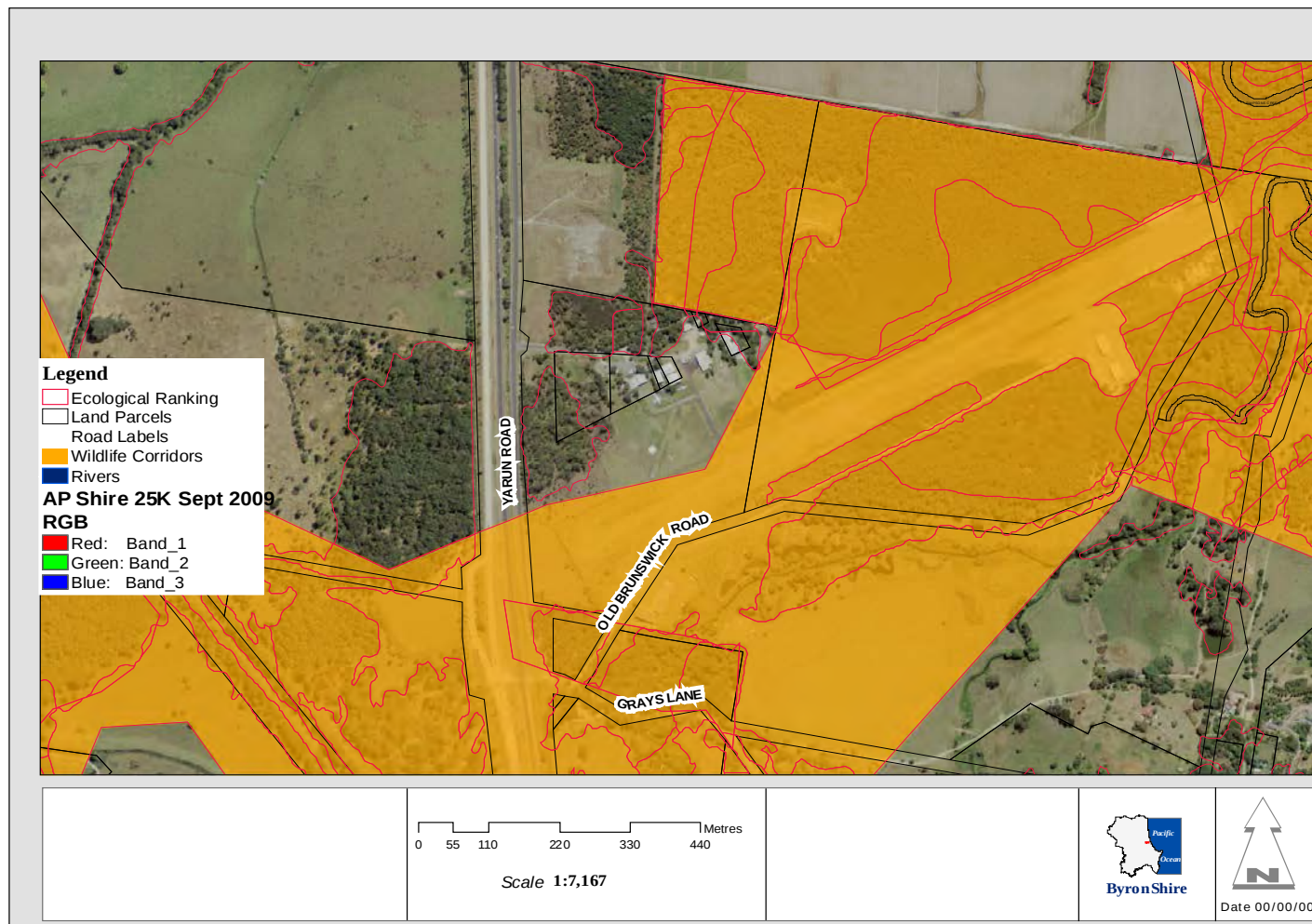
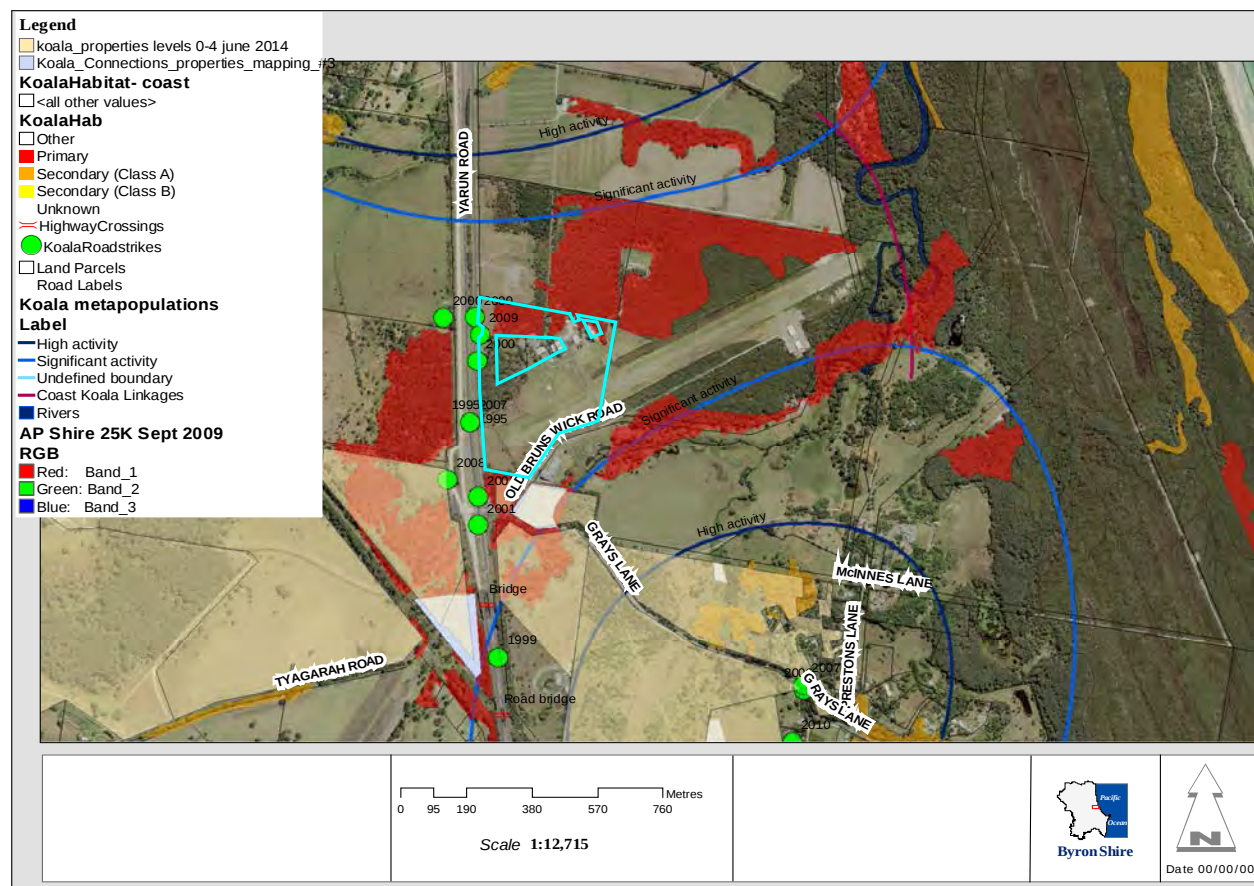


Figure 7: NPWS Wildlife Corridor mapping of site and surrounds (BSC)



The importance of the site for the local koala population can be seen above. The site sits between two known sub-populations, evidenced by “high” activity levels (dark blue lines) and “significant” activity levels (royal blue lines). Mapped Primary Koala habitat is shaded red, while properties participating in the Koala Connections habitat restoration program are shaded fawn in colour, with completed plantings shown in solid fawn. Koala deaths on the Pacific Highway have been recorded as lime green dots, increasing the importance of facilitating continued access through the property to the two underpasses to the south, illustrated as double red lines across the highway.

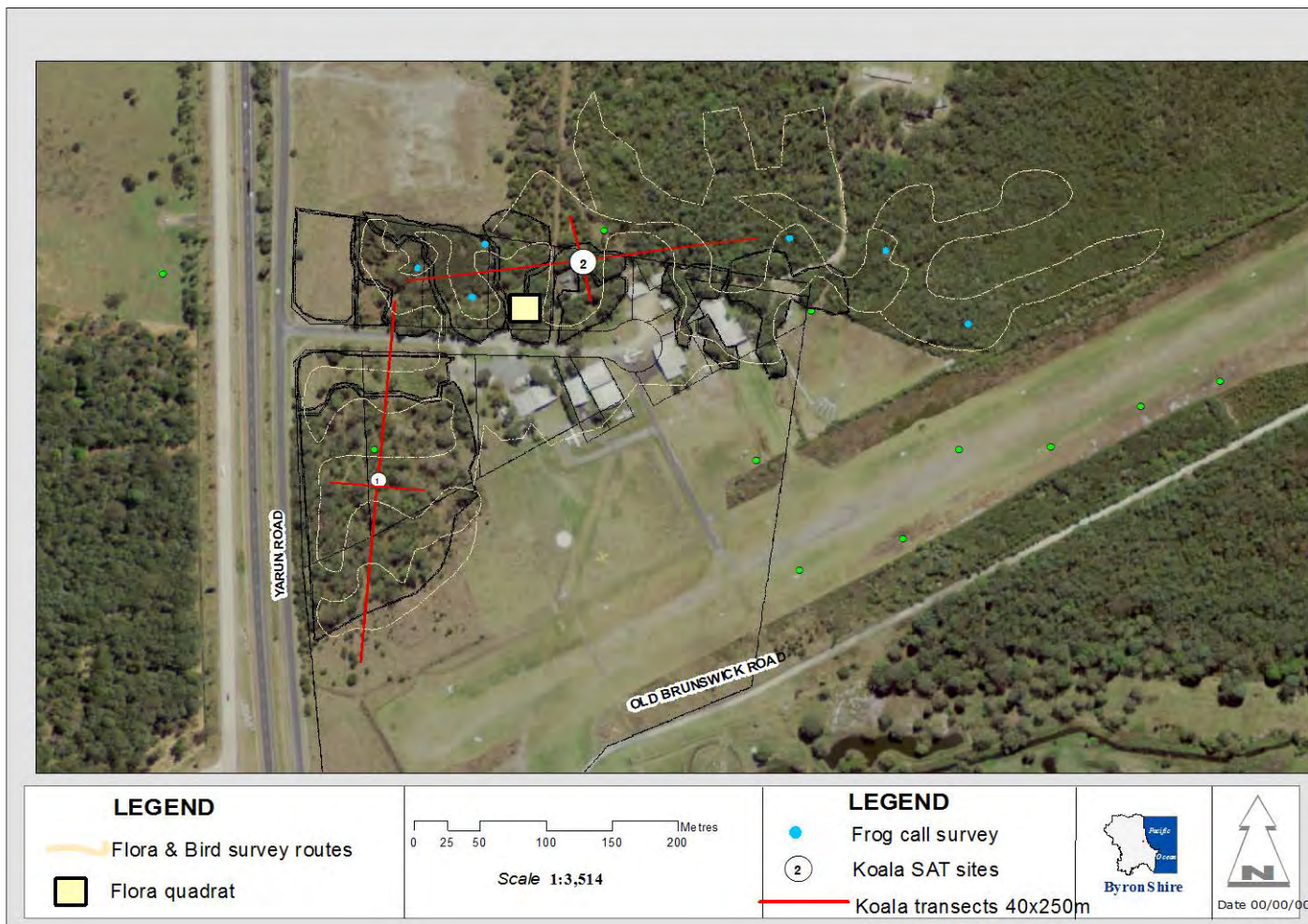


Figure 8: Survey Effort

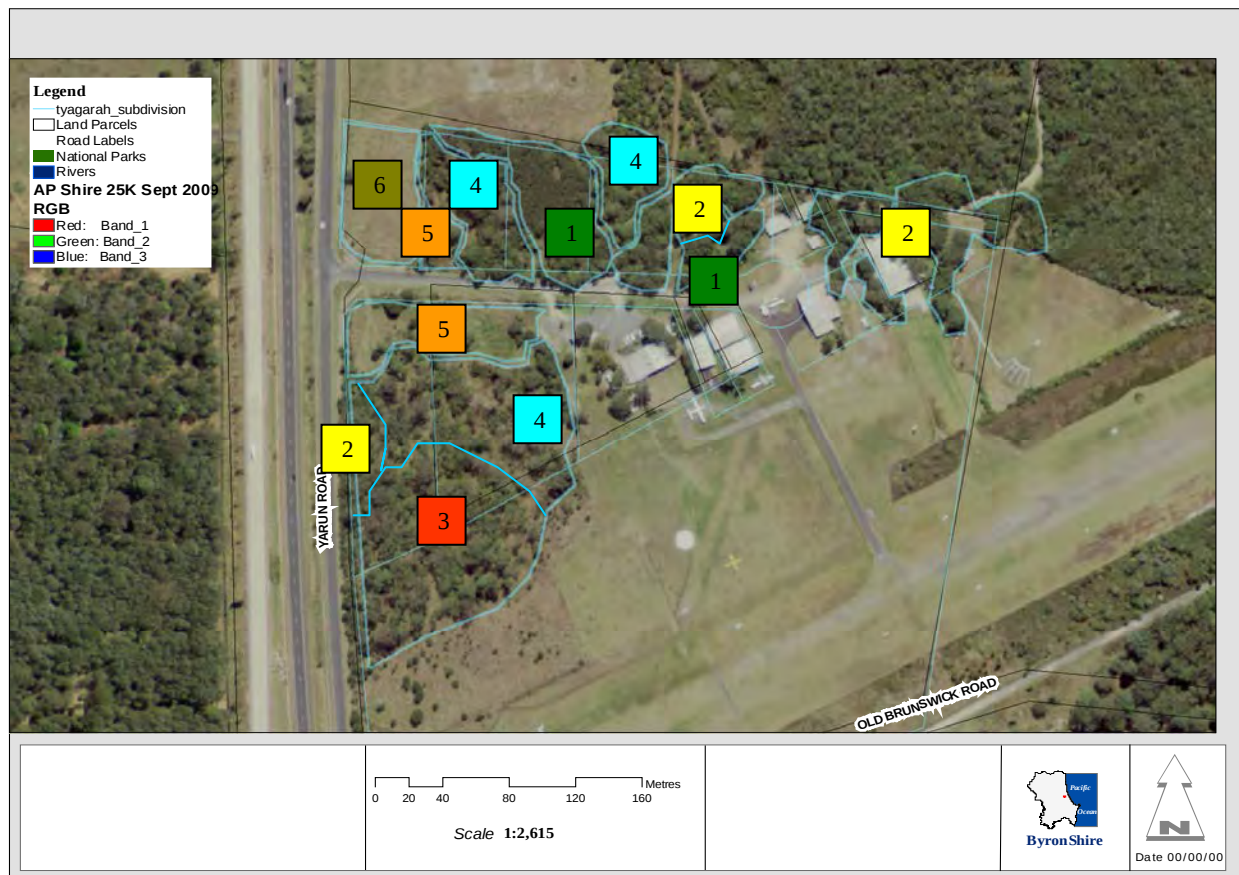


Figure 9: Detailed vegetation mapping of site and surrounds (BSC)

Vegetation communities on site are indicated as blue outlines. Numbers represent:

- | | |
|--|--|
| 1. Paperbark (<i>Melaleuca quinquenervia</i>) dominated Open to Closed Forest | 5. Regrowth vegetation <15 years |
| 2. Swamp Mahogany (<i>Eucalyptus robusta</i>) dominated Open Forest | 6. Closed grassland dominated by Setaria |
| 3. Forest Red Gum (<i>Eucalyptus tereticornis</i>) dominated Open Forest | |
| 4. Swamp Box (<i>Lophostemon suaveolens</i>) dominated Open Forest to Woodland | |

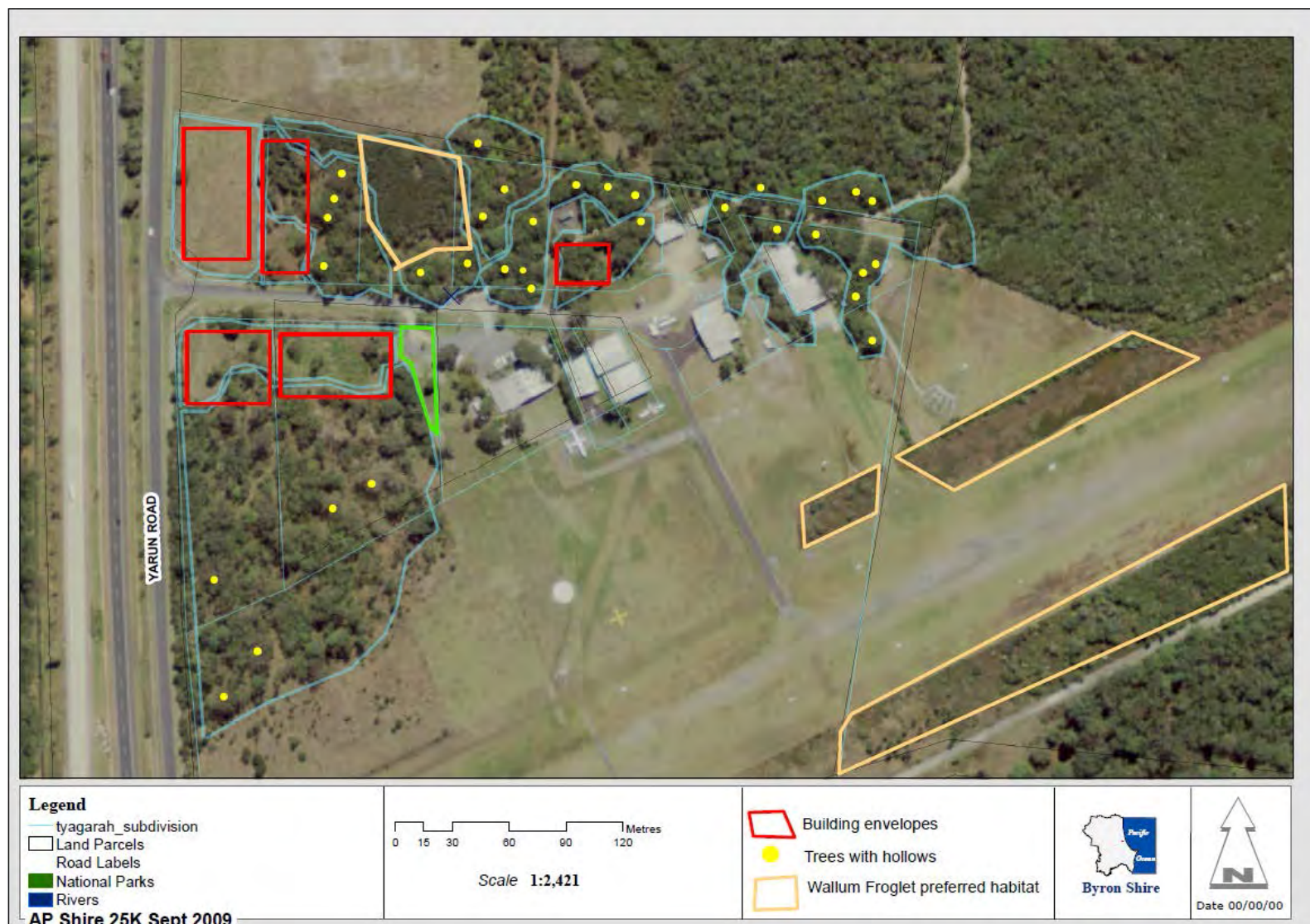


Figure 10: Location of building envelopes in relation to habitat



Figure 11: Accepted revised Lot layout and building envelopes

Orange lines depict new lot boundaries. Cream squares indicate building envelopes.
The green section indicates a proposed replanting area to maintain habitat connectivity.



Figure 12: Extent of habitat loss arising from the development.



Figure 13: Expected loss of Swamp Sclerophyll EEC and potential offset sites

PLATES



Plate 1:

Proposed Lot 1 is relatively unconstrained in ecological terms.

Note that an above-ground electricity line runs across the lot.



Plate 2:

Proposed Lot 2 comprises some regrowth vegetation as well as mature hollow-bearing trees. It has been reduced in size and moved westward to fit with previous clearing and avoid removal of mature trees.



Plate 3:

Proposed Lot 3 is constrained by Swamp Sclerophyll Forest. This lot will remain in Council ownership as part of a larger lot for conservation purposes.



Plate 4:

Proposed Lot 4 is constrained by Swamp Sclerophyll Forest. This lot will remain in Council ownership as part of a larger lot for conservation purposes.



Plate 5:

Proposed Lot 5 will require removal of some Swamp Sclerophyll Forest as shown (area between the road forks). The lot has been reduced in size from that originally proposed and realigned to avoid old-growth trees.



Plate 6:

Lots 6, 7, 8, 9, 10 & 11 are existing lots with current business or community operations. They will remain largely as they exist, with some minor boundary adjustments.



Plate 7 :

The area of proposed Lot 12 where building envelope is proposed to coincide with exotic grassland dominance.



Plate 8 :

The area of proposed Lot 13 where building envelope is proposed to coincide with exotic grassland dominance

APPENDIX 1: Flora Species list

**FLORA SPECIES RECORDED
on site and immediate surrounds**

FAMILY	SCIENTIFIC NAME	COMMON NAME
TREES		
Anacardiaceae	<i>Euroschinus falcata</i> var. <i>falcata</i>	Ribbonwood
Araliaceae	<i>Polyscias elegans</i>	Celery Wood
Araliaceae	<i>Schefflera actinophylla</i>	Umbrella Tree
Araucariaceae	<i>Araucaria cunninghamii</i> *	Hoop Pine
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
Arecaceae	<i>Livistona australis</i>	Cabbage Tree Palm
Casuarinaceae	<i>Allocastrum littoralis</i>	Black She-oak
Casuarinaceae	<i>Allocastrum torulosa</i> *	Forest Oak
Eleocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash
Euphorbiaceae	<i>Glochidion ferdinandii</i>	Cheese Tree
Euphorbiaceae	<i>Glochidion sumatranum</i>	Umbrella Cheese Tree
Euphorbiaceae	<i>Mallotus philippensis</i>	Red Kamala
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel
Lauraceae	<i>Endiandra sieberi</i>	Corkwood
Lauraceae	<i>Litsea australis</i>	Bolly Gum
Meliaceae	<i>Synoum glandulosum</i>	Scentless Rosewood
Mimosaceae	<i>Acacia disparrima</i> subsp. <i>disparrima</i>	Southern Salwood
Mimosaceae	<i>Acacia melanoxylon</i>	Blackwood
Moraceae	<i>Ficus watkinsiana</i>	Strangler Fig
Moraceae	<i>Morus alba</i> *	Mulberry
Moraceae	<i>Strebulus brunonianus</i>	Whalebone Tree
Myrsinaceae	<i>Myrsine howittiana</i>	Brush Muttonwood
Myrsinaceae	<i>Myrsine variabilis</i>	Muttonwood
Myrtaceae	<i>Acmena smithii</i>	Lillypilly
Myrtaceae	<i>Callistemon salignus</i>	Willow Bottlebrush
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood
Myrtaceae	<i>Corymbia intermedia</i>	Pink Bloodwood
Myrtaceae	<i>Eucalyptus microcorys</i>	Tallowwood
Myrtaceae	<i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i>	Red Mahogany
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum
Myrtaceae	<i>Lophostemon confertus</i>	Brush Box
Myrtaceae	<i>Lophostemon suaveolens</i>	Swamp Box
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
Myrtaceae	<i>Melaleuca stypheloides</i>	Prickly-leaved Tea Tree
Myrtaceae	<i>Syzygium australe</i>	Brush Cherry
Oleaceae	<i>Notelaea longifolia</i>	Mock Olive
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Proteaceae	<i>Banksia serrata</i>	Old Man Banksia
Proteaceae	<i>Grevillea robusta</i> *	Silky Oak
Proteaceae	<i>Grevillea baileyana</i>	White oak
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash
Rutaceae	<i>Acronychia imperforata</i>	Acronychia
Rutaceae	<i>Acronychia oblongifolia</i>	Common Acronychia
Rutaceae	<i>Melicope elleryana</i>	White Euodia
Sapindaceae	<i>Alectryon tomentosus</i>	Hairy Birds-eye
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo
Sapindaceae	<i>Guioa semiglauc</i>	Guioa
Ulmaceae	<i>Aphananthe philippinensis</i>	Rough-leaved Elm

FAMILY	BOTANICAL NAME	COMMON NAME
SHRUBS		

Apiaceae	<i>Platysace lanceolata</i>	Shrubby Platysace
Apocynaceae	<i>Alyxia ruscifolia</i>	Prickly Alyxia
Arecaceae	<i>Linospadix monostachya</i>	Walking-stick Palm
Asclepidaceae	<i>Gomphocarpus fruticosus*</i>	Narrow Leaf Cotton Bush
Asteliaceae	<i>Cordyline congesta</i>	Palm Lily
Asteliaceae	<i>Cordyline rubra</i>	
Asteraceae	<i>Chrysanthemoides monilifera subsp. monilifera*</i>	Bitou Bush
Cesalpinoideae	<i>Senna pendula var. glabrata*</i>	Winter Senna
Dilleniaceae	<i>Hibbertia acicularis</i>	Prickly Guinea Flower
Epacridaceae	<i>Acrotriche aggregata</i>	
Epacridaceae	<i>Epacris obtusifolia</i>	
Epacridaceae	<i>Epacris pulchella</i>	Coral Heath
Epacridaceae	<i>Leucopogon ericoides</i>	
Epacridaceae	<i>Leucopogon lanceolatus</i>	Lance-leaf Beard-heath
Epacridaceae	<i>Monotoca elliptica</i>	Tree Broom-heath
Epacridaceae	<i>Styphelia viridis subsp. viridis</i>	Green Five-corners
Epacridaceae	<i>Trochocarpa laurina</i>	Tree Heath
Euphorbiaceae	<i>Acalypha capillipes</i>	Small-leaved Acalypha
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush
Euphorbiaceae	<i>Croton acronychioides</i>	Thick-leaved Croton
Euphorbiaceae	<i>Omalanthus populifolius</i>	Bleeding Heart
Fabaceae	<i>Hovea acutifolia</i>	
Fabaceae	<i>Hovea longifolia</i>	
Faboideae	<i>Aotus ericoides</i>	
Malvaceae	<i>Hibiscus diversifolia</i>	Swamp Hibiscus
Malvaceae	<i>Hibiscus splendens</i>	Native Rosella
Melastomataceae	<i>Melastoma affine</i>	Blue Tongue
Mimosaceae	<i>Acacia falcata</i>	Sickle Wattle
Mimosaceae	<i>Acacia longifolia var. sophora</i>	Coastal wattle
Mimosaceae	<i>Acacia ulicifolia</i>	Prickly Moses
Monimiaceae	<i>Wilkiea heugeliana</i>	Veiny Wilkiea
Moraceae -	<i>Maclura cochinchinensis</i>	Cockspur
Myoporaceae	<i>Myoporum acuminatum</i>	
Myrsinaceae	<i>Myrsine variabilis</i>	Muttonwood
Myrtaceae	<i>Austromyrtus dulcis</i>	Midgen Berry
Myrtaceae	<i>Homoranthus virgatus</i>	
Myrtaceae	<i>Leptospermum juniperinum</i>	Prickly Tea-tree
Myrtaceae	<i>Leptospermum liversidgei</i>	Olive tea-tree
Myrtaceae	<i>Leptospermum polygalifolium</i>	Tantoon
Myrtaceae	<i>Leptospermum whitei</i>	Tea-tree
Myrtaceae	<i>Melaleuca nodosa</i>	Ball Honey Myrtle
Myrtaceae	<i>Pilidiostigma glabrum</i>	Plum Myrtle
Ochnaceae	<i>Ochna serrulata*</i>	Mickey Mouse Plant
Pittosporaceae	<i>Citriobatus loncifolius</i>	Narrow-leaved Orange Thorn
Pittosporaceae	<i>Pittosporum revolutum</i>	Yellow Pittosporum
Proteaceae	<i>Banksia ericifolia var. macrantha</i>	Heath-leaved Banksia
Proteaceae	<i>Banksia integrifolia subsp. integrifolia</i>	Coast Banksia
Proteaceae	<i>Banksia oblongifolia</i>	Fern-leaved Banksia
Proteaceae	<i>Banksia robur*</i>	Wallum Banksia
Proteaceae	<i>Banksia spinulosa</i>	Hairpin Banksia
Proteaceae	<i>Persoonia adenantha</i>	A Geebung
Proteaceae	<i>Persoonia virgata</i>	A Geebung
Proteaceae	<i>Persoonia stradbrokeiensis</i>	A Geebung
Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry
Rosaceae	<i>Rubus rosifolius</i>	Forest Bramble
Rubiaceae	<i>Canthium coprosmoides</i>	Coast Canthium
Rutaceae	<i>Nematolepis squamea</i>	Satinwood
Rutaceae	<i>Phebalium squamulosum</i>	Phebalium
Rutaceae	<i>Zieria smithii</i>	Sandfly Zieria
Santalaceae	<i>Leptomeria acida</i>	Native Currant
Sapindaceae	<i>Dodonaea triquetra</i>	Hop Bush
Solanaceae	<i>Duboisia myoporoides</i>	Corkwood
Solanaceae	<i>Solanum chenopodioides*</i>	Whitetip Nightshade
Solanaceae	<i>Solanum mauritianum*</i>	Wild Tobacco
Ulmaceae	<i>Trema tomentosa var. viridis</i>	Native Peach

Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum
Verbenaceae	<i>Lantana camara</i> *	Lantana

GROUNDCOVERS

Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed
Amaryllidaceae	<i>Crinum pedunculatum</i>	Swamp Lily
Apiaceae	<i>Centella asiatica</i>	Swamp Pennywort
Apiaceae	<i>Hydrocotyle bonariensis</i> *	Pennywort
Apiaceae	<i>Hydrocotyle peduncularis</i>	Pennywort
Araceae	<i>Gymnostachys anceps</i>	Settlers Twine
Asclepiadaceae	<i>Asclepias curassavica</i> *	Red-head Cottonbush
Asparagaceae	<i>Protasparagus aethiopicus</i> *	Asparagus Fern
Asteraceae	<i>Ageratina adenophorum</i> *	Crofton Weed
Asteraceae	<i>Ageratina riparia</i> *	Mist Flower
Asteraceae	<i>Ageratum houstonianum</i>	Blue Billy Goat Weed
Asteraceae	<i>Baccharis halimifolia</i> *	Groundsel Bush
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle
Asteraceae	<i>Conyza bonariensis</i> *	Flax-leaf Fleabane
Asteraceae	<i>Enydra fluctuans</i>	
Asteraceae	<i>Hypochaeris radicata</i> *	Flatweed
Asteraceae	<i>Leptinella longipes</i>	
Blechnaceae	<i>Sigesbeckia orientalis</i>	Indian Weed
Blechnaceae	<i>Blechnum cartilagineum</i>	Gristle Fern
Campanulaceae	<i>Blechnum indicum</i>	Swamp Water Fern
Caryophyllaceae	<i>Wahlenbergia stricta subsp. stricta</i>	Tall Bluebell
Caryophyllaceae	<i>Drymaria cordata</i> *	Tropical Chickweed
Commelinaceae	<i>Stellaria media</i> *	Common Chickweed
Cyperaceae	<i>Commelina cyanea</i>	Native Wandering Jew
Cyperaceae	<i>Baumea articulata</i>	Jointed Twig-rush
Cyperaceae	<i>Carex appressa</i>	Tall Sedge
Cyperaceae	<i>Carex declinata</i>	
Cyperaceae	<i>Carex maculata</i> -	
Cyperaceae	<i>Caustis flexuosa</i>	Curly Sedge
Cyperaceae	<i>Cyperus brevifolius</i> *	Mullumbimby Couch
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-rush
Cyperaceae	<i>Gahnia aspera</i>	Saw Sedge
Cyperaceae	<i>Gahnia clarkei</i>	Tall Saw-sedge
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge
Cyperaceae	<i>Ficinia nodosa</i>	Knobby Club-rush
Davalliaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge
Dennstaedtiaceae	<i>Rhynchospora corymbosa</i>	
Dennstaedtiaceae	<i>Nephrolepis cordifolia</i>	Fish-bone Fern
Dennstaedtiaceae	<i>Histiopteris incisa</i>	Bat's Wing Fern
Dicksoniaceae	<i>Hypolepis muelleri</i>	Harsh Ground Fern
Dilleniaceae	<i>Pteridium esculentum</i>	Bracken
Dilleniaceae	<i>Calochlaena dubia</i>	False Bracken
Fabaceae	<i>Hibbertia diffusa</i>	Wedge Guinea Flower
Gleicheniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower
Haloragaceae	<i>Trifolium repens</i> *	White Clover
Haloragaceae	<i>Gleichenia dicarpa</i>	Pouched Coral Fern
Haloragaceae	<i>Gonocarpus oreophilus</i>	
Juncaceae	<i>Gonocarpus tetragynus</i>	Poverty Raspwort
Juncaceae	<i>Juncus acutus</i> *	
Juncaceae	<i>Juncus articulatus</i>	Jointed Rush
Lamiaceae	<i>Juncus usitatus</i>	Common Rush
Liliaceae	<i>Plectranthus spp.</i>	Cockspur Flower
Lomandraceae	<i>Lilium formosanum</i> *	Formosan Lily
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Malvaceae	<i>Lomandra hystrix</i>	A mat-rush
Orchidaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne
Orchidaceae	<i>Cryptostylis subulata</i>	Large Tongue Orchid

Orchidaceae	<i>Dendrobium linguiforme</i>	Thumbail Orchid
Orchidaceae	<i>Dendrobium speciosum</i>	Rock Lily
Osmundaceae	<i>Microtis unifolia</i>	Common Onion Orchid
Oxalidaceae	<i>Todea barbara</i>	King Fern
Phormiaceae	<i>Oxalis corniculata*</i>	Yellow Wood Sorrel
Plantaginaceae	<i>Dianella caerulea</i>	Blue Flax Lily
Poaceae	<i>Plantago lanceolata*</i>	Ribwort
Poaceae	<i>Andropogon virginicus*</i>	Whisky Grass
Poaceae	<i>Axonopus affinis*</i>	Narrow-leaved Carpet Grass
Poaceae	<i>Briza maxima*</i>	Quaking Grass
Poaceae	<i>Briza minor*</i>	Shivery Grass
Poaceae	<i>Bromus cartharticus*</i>	Prairie Grass
Poaceae	<i>Chloris gayana*</i>	Rhodes Grass
Poaceae	<i>Cortaderia selloana*</i>	Pampas Grass
Poaceae	<i>Cymbopogon refractus</i>	Barbwire Grass
Poaceae	<i>Cynodon dactylon</i>	Common Couch
Poaceae	<i>Digitaria sanguinalis*</i>	Crab Grass
Poaceae	<i>Ehrharta erecta*</i>	Panic Veldtgrass
Poaceae	<i>Entolasia marginata</i>	Bordered Panic
Poaceae	<i>Entolasia stricta</i>	Wiry Panic
Poaceae	<i>Eragrostis brownii</i>	Brown.s Lovegrass
Poaceae	<i>Eragrostis curvula*</i>	African Lovegrass
Poaceae	<i>Imperata cylindrica var. major</i>	Blady Grass
Poaceae	<i>Lachnagrostis filiformis</i>	Blown Grass
Poaceae	<i>Lolium perenne*</i>	Perennial Ryegrass
Poaceae	<i>Melinis repens*</i>	Red Natal Grass
Poaceae	<i>Microlaena stipoides var. stipoides</i>	Weeping Rice Grass
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass
Poaceae	<i>Panicum maximum*</i>	Guinea Grass
Poaceae	<i>Panicum simile</i>	Two Colour Panic
Poaceae	<i>Paspalum dilatatum*</i>	Paspalum
Poaceae	<i>Paspalum mandiocanum*</i>	Broadleaf paspalum
Poaceae	<i>Paspalum urvillei*</i>	Vasey Grass
Poaceae	<i>Pennisetum alopecuroides*</i>	Swamp Foxtail Grass
Poaceae	<i>Pennisetum clandestinum*</i>	Kikuyu
Poaceae	<i>Setaria sphacelata*</i>	South African Pigeon Grass
Polygonaceae	<i>Sporobolus africanus*</i>	Parramatta Grass
Polygonaceae	<i>Stenotaphrum secundatum*</i>	Buffalo Grass
Primulaceae	<i>Persicaria hydropiper</i>	Water Pepper
Primulaceae	<i>Rumex brownii</i>	Swamp Dock
Ranunculaceae	<i>Anagallis arvensis*</i>	Scarlet Pimpernel
Ranunculaceae	<i>Ranunculus plebeius</i>	Hairy Buttercup
Restionaceae	<i>Baloskion tetraphyllum subsp. meiestachyum</i>	Plume Rush
Rubiaceae	<i>Pomax umbellata</i>	Pomax
Rubiaceae	<i>Richardia brasiliensis*</i>	White Eye
Scrophulariaceae	<i>Veronica plebia</i>	Creeping Speedwell
Sinopteridaceae	<i>Cheilanthes sieberi subsp. sieberi</i>	Poison Rock Fern
Thymelaeaceae	<i>Pimelea linifolia subsp. linifolia</i>	Slender Rice Flower
Verbenaceae	<i>Verbena bonariensis*</i>	Purpletop
Verbenaceae	<i>Verbena officinalis*</i>	Common Verbena
Violaceae	<i>Viola hederacea</i>	Ivy-leaved Violet
Xanthorrhoeaceae	<i>Xanthorrhoea macronema</i>	A Grass Tree
Zingiberaceae	<i>Alpinia caerulea</i>	Native Ginger

EPIPHYTES

Aspleniaceae	<i>Asplenium australasicum</i>	Birds Nest Fern
Loranthaceae	<i>Amyema congener subsp. congener</i>	Mistletoe
Orchidaceae	<i>Cymbidium madidum</i>	Native Cymbidium
Polypodiaceae	<i>Dendrobium teretifolium</i>	Pencil Orchid
Polypodiaceae	<i>Platyterium bifurcatum subsp. bifurcatum</i>	Elkhorn
Polypodiaceae	<i>Platyterium superbum</i>	Staghorn
	<i>Pyrrosia rupestris</i>	Rock Felt Fern

VINES

Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod
Arecaceae	<i>Calamus muelleri</i>	Lawyer Vine
Asclepiadaceae	<i>Araujia hortorum*</i>	Mothvine
Asclepiadaceae	<i>Marsdenia fraseri</i>	Marsdenia
Bignoniaceae	<i>Marsdenia rostrata</i>	Common Milk Vine
Convolvulaceae	<i>Pandorea pandorana</i>	Wonga Vine
Dilleniaceae	<i>Ipomoea indica*</i>	Coastal Morning Glory
Dioscoreaceae	<i>Hibbertia scandens</i>	Climbing Guinea-flower
Fabaceae	<i>Dioscorea transversa</i>	Native Yam
Fabaceae	<i>Derris involuta</i>	Deris
Fabaceae	<i>Glycine clandestina</i>	Twining Glycine
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea
Flagellariaceae	<i>Macroptilium atropurpureum</i>	Siratro
Lauraceae	<i>Flagellaria indica</i>	Whip Vine
Lauraceae	<i>Cassytha glabella f. glabella</i>	Slender Devil's Twine
Luzuriagaceae	<i>Cassytha pubescens</i>	Common Devils Twine
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
Menispermaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Passifloraceae	<i>Stephania japonica var. discolor</i>	Snake Vine
Ranunculaceae	<i>Passiflora suberosa*</i>	Corky Passionflower
Rubiaceae	<i>Clematis aristata</i>	Old Man's Beard
Schizaeaceae	<i>Morinda jasminoides</i>	Morinda
Smilacaceae	<i>Lygodium microphyllum</i>	Climbing Snake Fern
Smilacaceae	<i>Smilax australis</i>	Lawyer Vine
Vitaceae	<i>Smilax glycyphylla</i>	Sarsaparilla
Vitaceae	<i>Cayratia clematidea</i>	Slender Grape
	<i>Cissus hypoglauca</i>	Water Vine

APPENDIX 2: Fauna Species list

Notes to Table

Status means whether listed as threatened species under the NSW TSC Act (E1=Endangered; V=Vulnerable) or Commonwealth EPBC Act (E= Endangered; V=Vulnerable). All native fauna are Protected under the TSC Act.
Recorded species are listed by method recorded. O=observed; C=heard by call; S=scat; D=characteristic diggings, Sc=characteristic scratch marks. PS=recorded on the site from Previous Survey of airfield land (McAlpin 2008; Fitzgerald 2013). Where recorded during this survey and previously, both are used.

Expected species are those recorded nearby and/or for which suitable habitat for all lifecycle components are present.

*= introduced pest species

FAUNA SPECIES RECORDED and EXPECTED on site

COMMON NAME		SCIENTIFIC NAME		RECORDED	EXPECTED
Amphibians					
		STATUS			
HYLIDAE		TSC	EPBC		
<i>Litoria caerulea</i>	Green Tree Frog			PS	
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog			PS	
<i>Litoria gracilencis</i>	Dainty Green Tree-frog				X
<i>Litoria nasuta</i>	Rocket Frog			PS	
<i>Litoria olongburensis</i>	Olongburra Frog	V	V	PS	
MYOBATRACHIDAE					
<i>Crinia parinsignifera</i>	Beeping Froglet				X
<i>Crinia signifera</i>	Common Eastern Froglet			C	
<i>Crinia tinnula</i>	Wallum Froglet	V		PS	
<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog				X
<i>Limnodynastes peroni</i>	Brown-striped Frog			PS	
<i>Pseudophyrne coriacea</i>	Red-backed Toadlet				X
BUFONIDAE					
<i>Rhinella marina</i> *	Cane Toad*			O, PS	
Birds					
ACANTHIZIDAE					
<i>Acanthiza pusilla</i>	Brown Thornbill			O, PS	
<i>Sericornis frontalis</i>	White-browed Scrubwren			O	
<i>Gerygone olivacea</i>	White-throated Gerygone			O, PS	
<i>Acanthiza pusilla</i>	Brown Thornbill			O	
<i>Acanthiza lineata</i>	Striated Thornbill			C	
ANATIDAE					
	Australian Wood Duck				X
<i>Chenonetta jubata</i>	Maned Duck			PS	
ACCIPTRIDAE					
<i>Accipiter fasciatus</i>	Brown Goshawk			PS	
<i>Aviceda subcristata</i>	Pacific Baza			O	
<i>Haliastur indus</i>	Brahminy Kite			PS	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle			O	
	Black-shouldered Kite			O	
<i>Haliastur spherurus</i>	Whistling Kite			PS	
ARDEIDAE					
	White-faced Heron			PS	
	Australian White Ibis				X
	Straw-necked Ibis			O	
ARTAMIDAE					
	Pied Butcherbird			C	
	Grey Butcherbird			C	
	Australian Magpie			C	
	Pied Currawong			C	
CENTROPIDAE					
	Pheasant Coucal			C, PS	
CHARADRIIDAE					
	Masked Lapwing			O, PS	
CAMPEPHAGIDAE					
	Black-faced Cuckoo-shrike			O	
COLUMBIDAE					
	White-headed Pigeon			C	

	Bar-shouldered Dove			PS	
	Peaceful Dove			PS	
	Crested Pigeon			C	
	Brown Cuckoo-dove			C	
	Brush Cuckoo				X
	Fan-tailed Cuckoo				X
CORVIDAE					
	Australian Raven			O	
	Torresian Crow			C	
CUCULIDAE					
	Fan-tailed Cuckoo			C	
DICAEIIDAE					
	Mistletoe Bird			C, PS	
DICRURIDAE					
	Spangled Drongo			PS	
ESTRILDADAE					
	Red-browed Finch			O, PS	
HALCYONIDAE					
	Laughing Kookaburra			C, PS	
HIRUNDINDAE					
	Welcome Swallow			PS	
GRUIDAE					
	Brolga	V		PS	
MALURIDAE					
	Superb Fairy-wren			O	
	Large-billed Scrub-wren			O	X
	White-browed Scrub-wren				
	Variegated Fairy-wren			O	
MELIPHAGIDAE					
	Little Friarbird			O	
	Nosy Friarbird			PS	
	Noisy Moner			PS	
	Lewin's Honeyeater			O	
	Yellow-faced Honeyeater			PS	
	Eastern Spinebill			O	
	Scarlet Honeyeater			O	
	Blue-faced Honeyeater			O	
	White-cheeked Honeyeater			O	
	Little Wattlebird			C	
MEROPIDAE					
	Rainbow Bee-eater			O, PS	
MONARCHIDAE					
	White-eared Monarch			O; PS	
	Black-faced Monarch				
	Grey Fantail			PS	
	Magpie-lark			O	
<i>Myiagra rubecula</i>	Leaden Flycatcher			O	
	Willie Wagtail			O	
ORIOIDAE					
	Figbird			PS	
	Olive-backed Oriole			O	
ORTHONYCHIDAE					
	Eastern Whipbird			C, PS	
PACHYCEPHALIDAE					
	Grey Shrike-thrush			PS	
	Little Shrike-thrush			O, PS	
	Golden Whistler			C, PS	
	Rufous Whistler			PS	
PARDALOTIDAE					
	Striated Pardalote			O, PS	
PHALACROCORDIAE					

	Great Cormorant			PS	
PETROICIDAE					
	Rose Robin			PS	
	Eastern Yellow Robin			O, PS	
PODARGIDAE					
	Tawny Frogmouth			PS	
PSITTACIDAE					
	Rainbow Lorikeet			O	
	Scaly-breasted Lorikeet			O	
	Eastern Rosella			O	
SYLVIIDAE					
<i>Megalurus timoriensis</i>	Tawny Grassbird			PS	
ZOSTEROPIDAE					
	Silvereye			O, PS	
<i>Falco longipennis</i>	Australian Hobby				X
	Nankeen Kestrel				X
	Australian Owlet-nightjar				X
	Red-browed Finch				X
Mammals					
CANIDAE					
	Dog*			PS	
FELIDAE					
	Cat*			PS	
MACROPODIDAE					
	Swamp Wallaby			S, PS	
PERAMELIDAE					
<i>Perameles nasuta</i>	Long-nosed Bandicoot			S, D, PS	
PHASCOLARCTIDAE					
<i>Phascolarctus cinereus</i>	Koala			S, PS	
PSEUDOCHEIRIDAE					
	Ring-tailed Possum			PS	
<i>Trichosurus caninus</i>	Bobuck			S	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum				X
PTEROPODIDAE					
<i>Pteropus poliocephalis</i>	Grey-headed Flying-fox			PS	X
	Black Flying-fox				
<i>Rattus fuscipes</i>	Bush Rat			S	X
	Echidna			D, S	
	Sugar Glider				X
<i>Oryctolagus cuniculus</i>	Rabbit*				X
	Hare*			S	
<i>Vulpes vulpes</i>	Red Fox*			S	
	House Mouse*				
	Little Bent-wing Bat	V			X
	Eastern False Pipistrelle				X
	Eastern Forest Bat				X
	Eastern Freetail Bat				X
	Eastern Long-eared Bat				X
	Goulds Wattled Bat				
	Eastern Horseshoe Bat			D, S	
Reptiles					
AGAMIDAE					
	Bearded Dragon				X
	Water Dragon			PS	
BOIDAE					
	Carpet Python			PS	
COLUBRIDAE					
	Common Tree Snake			PS	
ELAPIDAE					
	Black-bellied Swamp Snake			PS	
	Eastern Brown Snake			PS	

	Eastern Small-eyed Snake				X
	Red-bellied Black Snake			PS	
SCINCIDAE					
	Garden Sun-skink			O, PS	
	Fence Skink			PS	
	Pale-flecked sun-skink			O, PS	
	Dark-flecked Sun-skink			O	
	Lace Monitor			Sc	X

APPENDIX 4: Wildlife Atlas, EPBC Search results

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.

Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°).

Copyright the State of NSW through the Office of Environment and Heritage.

Search criteria : Public Report of all Valid Records of Animals in selected area

[North: -28.54 West: 153.49 East: 153.59 South: -28.64] returned a total of 27,086 records of 360 species.

Report generated on 12/08/2014 4:14 PM

Class	Family	Scientific Name	Exotic	Common Name	NSW status	Comm. status
Amphibia	Myobatrachidae	<i>Crinia parinsignifera</i>		Eastern Sign-bearing Froglet	P	
Amphibia	Myobatrachidae	<i>Crinia signifera</i>		Common Eastern Froglet	P	
Amphibia	Myobatrachidae	<i>Crinia tinnula</i>		Wallum Froglet	V,P	
Amphibia	Myobatrachidae	<i>Limnodynastes peronii</i>		Brown-striped Frog	P	
Amphibia	Myobatrachidae	<i>Limnodynastes terraereginae</i>		Northern Banjo Frog	P	
Amphibia	Myobatrachidae	<i>Mixophyes fasciolatus</i>		Great Barred Frog	P	
Amphibia	Myobatrachidae	<i>Pseudophryne coriacea</i>		Red-backed Toadlet	P	
Amphibia	Hylidae	<i>Litoria aurea</i>		Green and Golden Bell Frog	E1,P	V
Amphibia	Hylidae	<i>Litoria caerulea</i>		Green Tree Frog	P	
Amphibia	Hylidae	<i>Litoria dentata</i>		Bleating Tree Frog	P	
Amphibia	Hylidae	<i>Litoria fallax</i>		Eastern Dwarf Tree Frog	P	
Amphibia	Hylidae	<i>Litoria freycineti</i>		Freycinet's Frog	P	
Amphibia	Hylidae	<i>Litoria gracilentia</i>		Dainty Green Tree Frog	P	
Amphibia	Hylidae	<i>Litoria nasuta</i>		Rocket Frog	P	
Amphibia	Hylidae	<i>Litoria olongburensis</i>		Olongburra Frog	V,P	V
Amphibia	Hylidae	<i>Litoria peronii</i>		Peron's Tree Frog	P	
Amphibia	Hylidae	<i>Litoria tyleri</i>		Tyler's Tree Frog	P	
Amphibia	Bufonidae	<i>Rhinella marina</i>	*	Cane Toad		
Reptilia	Cheloniidae	<i>Eretmochelys imbricata</i>		Hawksbill Turtle	P	
Reptilia	Pygopodidae	<i>Lialis burtonis</i>		Burton's Snake-lizard	P	

Reptilia	Pygopodidae	<i>Pygopus lepidopodus</i>	Common Scaly-foot	P
Reptilia	Scincidae	<i>Bellatorias frerei</i>	Major Skink	P
Reptilia	Scincidae	<i>Bellatorias major</i>	Land Mullet	P
Reptilia	Scincidae	<i>Cryptoblepharus pulcher</i>		P
Reptilia	Scincidae	<i>Cryptoblepharus virgatus</i>	Cream-striped Shinning-skink	P
Reptilia	Scincidae	<i>Ctenotus robustus</i>	Robust Ctenotus	P
Reptilia	Scincidae	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	P
Reptilia	Scincidae	<i>Eulamprus quoyii</i>	Eastern Water-skink	P
Reptilia	Scincidae	<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	P
Reptilia	Scincidae	<i>Saiphos equalis</i>	Three-toed Skink	P
Reptilia	Scincidae	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	P
Reptilia	Agamidae	<i>Amphibolurus muricatus</i>	Jacky Lizard	P
Reptilia	Agamidae	<i>Intellagama lesueurii</i>	Eastern Water Dragon	P
Reptilia	Agamidae	<i>Pogona barbata</i>	Bearded Dragon	P
Reptilia	Varanidae	<i>Varanus sp.</i>	Unidentified Goanna	P
Reptilia	Varanidae	<i>Varanus varius</i>	Lace Monitor	P
Reptilia	Typhlopidae	<i>Ramphotyphlops nigrescens</i>	Blackish Blind Snake	P
Reptilia	Boidae	<i>Morelia spilota</i>	Carpet & Diamond Pythons	P
Reptilia	Boidae	<i>Morelia spilota mcdowelli</i>	Eastern Carpet Python	P
Reptilia	Colubridae	<i>Dendrelaphis punctulatus</i>	Common Tree Snake	P
Reptilia	Elapidae	<i>Cacophis krefftii</i>	Southern Dwarf Crowned Snake	P
Reptilia	Elapidae	<i>Cryptophis nigrescens</i>	Eastern Small-eyed Snake	P
Reptilia	Elapidae	<i>Demansia psammophis</i>	Yellow-faced Whip Snake	P
Reptilia	Elapidae	<i>Hemiaspis signata</i>	Black-bellied Swamp Snake	P
Reptilia	Elapidae	<i>Notechis scutatus</i>	Tiger Snake	P
Reptilia	Elapidae	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P
Reptilia	Elapidae	<i>Pseudechis sp.</i>	Unidentified Black Snake	P

Reptilia	Elapidae	<i>Pseudonaja sp.</i>	Unidentified Brown Snake	P
Reptilia	Elapidae	<i>Pseudonaja textilis</i>	Eastern Brown Snake	P
Reptilia	Elapidae	<i>Tropidechis carinatus</i>	Rough-scaled Snake	P
Reptilia	Elapidae	<i>Vermicella annulata</i>	Bandy-bandy	P
Aves	Megapodiidae	<i>Alectura lathamii</i>	Australian Brush-turkey	P
Aves	Phasianidae	<i>Coturnix ypsilophora</i>	Brown Quail	P
Aves	Phasianidae	<i>Excalfactoria chinensis</i>	King Quail	P
Aves	Phasianidae	<i>Pavo cristatus</i>	* Indian Peafowl	
Aves	Anatidae	<i>Anas castanea</i>	Chestnut Teal	P
Aves	Anatidae	<i>Anas gracilis</i>	Grey Teal	P
Aves	Anatidae	<i>Anas platyrhynchos</i>	* Mallard	
Aves	Anatidae	<i>Anas rhynchotis</i>	Australasian Shoveler	P
Aves	Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck	P
Aves	Anatidae	<i>Aythya australis</i>	Hardhead	P
Aves	Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck	P
Aves	Anatidae	<i>Cygnus atratus</i>	Black Swan	P
Aves	Anatidae	<i>Dendrocygna eytoni</i>	Plumed Whistling-Duck	P
Aves	Anatidae	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	P
Aves	Anatidae	<i>Stictonetta naevosa</i>	Freckled Duck	V,P
Aves	Podicipedidae	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	P
Aves	Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	P
Aves	Columbidae	<i>Chalcophaps indica</i>	Emerald Dove	P
Aves	Columbidae	<i>Columba leucomela</i>	White-headed Pigeon	P
Aves	Columbidae	<i>Columba livia</i>	* Rock Dove	
Aves	Columbidae	<i>Geopelia humeralis</i>	Bar-shouldered Dove	P
Aves	Columbidae	<i>Geopelia striata</i>	Peaceful Dove	P
Aves	Columbidae	<i>Leucosarcia melanoleuca</i>	Wonga Pigeon	P

Aves	Columbidae	<i>Lopholaimus antarcticus</i>	Topknot Pigeon	P	
Aves	Columbidae	<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove	P	
Aves	Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	P	
Aves	Columbidae	<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V,P	
Aves	Columbidae	<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V,P	
Aves	Columbidae	<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V,P	
Aves	Columbidae	<i>Streptopelia chinensis</i>	* Spotted Turtle-Dove		
Aves	Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth	P	
Aves	Caprimulgidae	<i>Eurostopodus mystacalis</i>	White-throated Nightjar	P	
Aves	Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	P	
Aves	Apodidae	<i>Apus pacificus</i>	Fork-tailed Swift	P	C,J,K
Aves	Apodidae	<i>Hirundapus caudacutus</i>	White-throated Needletail	P	C,J,K
Aves	Procellariidae	<i>Ardenna pacificus</i>	Wedge-tailed Shearwater	P	J
Aves	Procellariidae	<i>Pterodroma nigripennis</i>	Black-winged Petrel	V,P	
Aves	Sulidae	<i>Morus serrator</i>	Australasian Gannet	P	
Aves	Anhingidae	<i>Anhinga novaehollandiae</i>	Australasian Darter	P	
Aves	Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	P	
Aves	Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant	P	
Aves	Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	P	
Aves	Phalacrocoracidae	<i>Phalacrocorax varius</i>	Pied Cormorant	P	
Aves	Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican	P	
Aves	Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1,P	
Aves	Ardeidae	<i>Ardea ibis</i>	Cattle Egret	P	C,J
Aves	Ardeidae	<i>Ardea intermedia</i>	Intermediate Egret	P	
Aves	Ardeidae	<i>Ardea modesta</i>	Eastern Great Egret	P	
Aves	Ardeidae	<i>Ardea pacifica</i>	White-necked Heron	P	
Aves	Ardeidae	<i>Ardea/Egretta sp.</i>	Unidentified Egret	P	

Aves	Ardeidae	<i>Botaurus poiciloptilus</i>	Australasian Bittern	E1,P	E
Aves	Ardeidae	<i>Butorides striatus</i>	Striated Heron	P	
Aves	Ardeidae	<i>Egretta garzetta</i>	Little Egret	P	
Aves	Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	P	
Aves	Ardeidae	<i>Egretta sacra</i>	Eastern Reef Egret	P	C
Aves	Ardeidae	<i>Ixobrychus dubius</i>	Australian Little Bittern	P	
Aves	Ardeidae	<i>Ixobrychus flavicollis</i>	Black Bittern	V,P	
Aves	Ardeidae	<i>Nycticorax caledonicus</i>	Nankeen Night Heron	P	
Aves	Threskiornithidae	<i>Platalea flavipes</i>	Yellow-billed Spoonbill	P	
Aves	Threskiornithidae	<i>Platalea regia</i>	Royal Spoonbill	P	
Aves	Threskiornithidae	<i>Plegadis falcinellus</i>	Glossy Ibis	P	C
Aves	Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis	P	
Aves	Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	P	
Aves	Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	P	
Aves	Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk	P	
Aves	Accipitridae	<i>Accipiter novaehollandiae</i>	Grey Goshawk	P	
Aves	Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	P	
Aves	Accipitridae	<i>Aviceda subcristata</i>	Pacific Baza	P	
Aves	Accipitridae	<i>Circus approximans</i>	Swamp Harrier	P	
Aves	Accipitridae	<i>Circus assimilis</i>	Spotted Harrier	V,P	
Aves	Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite	P	
Aves	Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	P	C
Aves	Accipitridae	<i>Haliastur indus</i>	Brahminy Kite	P	
Aves	Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite	P	
Aves	Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle	V,P	
Aves	Accipitridae	<i>Milvus migrans</i>	Black Kite	P	
Aves	Accipitridae	<i>^Pandion cristatus</i>	Eastern Osprey	V,P,3	

Aves	Falconidae	<i>Falco berigora</i>	Brown Falcon	P	
Aves	Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	P	
Aves	Falconidae	<i>Falco peregrinus</i>	Peregrine Falcon	P	
Aves	Gruidae	<i>Grus rubicunda</i>	Brolga	V,P	
Aves	Rallidae	<i>Amaurornis moluccana</i>	Pale-vented Bush-hen	V,P	
Aves	Rallidae	<i>Fulica atra</i>	Eurasian Coot	P	
Aves	Rallidae	<i>Gallinula tenebrosa</i>	Dusky Moorhen	P	
Aves	Rallidae	<i>Gallirallus philippensis</i>	Buff-banded Rail	P	
Aves	Rallidae	<i>Lewinia pectoralis</i>	Lewin's Rail	P	
Aves	Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphe	P	
Aves	Rallidae	<i>Porzana pusilla</i>	Baillon's Crake	P	
Aves	Rallidae	<i>Porzana tabuensis</i>	Spotless Crake	P	
Aves	Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew	E1,P	
Aves	Haematopodidae	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V,P	
Aves	Haematopodidae	<i>Haematopus longirostris</i>	Pied Oystercatcher	E1,P	
Aves	Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt	P	
Aves	Charadriidae	<i>Charadrius ruficapillus</i>	Red-capped Plover	P	
Aves	Charadriidae	<i>Elseyornis melanops</i>	Black-fronted Dotterel	P	
Aves	Charadriidae	<i>Erythronys cinctus</i>	Red-kneed Dotterel	P	
Aves	Charadriidae	<i>Pluvialis dominicus</i>	American Golden Plover	P	
Aves	Charadriidae	<i>Pluvialis fulva</i>	Pacific Golden Plover	P	C,J,K
Aves	Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	P	
Aves	Jacaniidae	<i>Irediparra gallinacea</i>	Comb-crested Jacana	V,P	
Aves	Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper	P	C,J,K
Aves	Scolopacidae	<i>Arenaria interpres</i>	Ruddy Turnstone	P	C,J,K
Aves	Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	P	C,J,K
Aves	Scolopacidae	<i>Calidris ferruginea</i>	Curlew Sandpiper	E1,P	C,J,K

Aves	Scolopacidae	<i>Calidris melanotos</i>	Pectoral Sandpiper	P	J,K
Aves	Scolopacidae	<i>Calidris ruficollis</i>	Red-necked Stint	P	C,J,K
Aves	Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe	P	C,J,K
Aves	Scolopacidae	<i>Limosa lapponica</i>	Bar-tailed Godwit	P	C,J,K
Aves	Scolopacidae	<i>Numenius madagascariensis</i>	Eastern Curlew	P	C,J,K
Aves	Scolopacidae	<i>Numenius phaeopus</i>	Whimbrel	P	C,J,K
Aves	Scolopacidae	<i>Tringa brevipes</i>	Grey-tailed Tattler	P	C,J,K
Aves	Scolopacidae	<i>Tringa nebularia</i>	Common Greenshank	P	C,J,K
Aves	Scolopacidae	<i>Tringa stagnatilis</i>	Marsh Sandpiper	P	C,J,K
Aves	Turnicidae	<i>Turnix sp.</i>	Unidentified Button-quail	P	
Aves	Turnicidae	<i>Turnix varius</i>	Painted Button-quail	P	
Aves	Laridae	<i>Anous minutus</i>	Black Noddy	P	
Aves	Laridae	<i>Chlidonias hybrida</i>	Whiskered Tern	P	
Aves	Laridae	<i>Chroicocephalus novaehollandiae</i>	Silver Gull	P	
Aves	Laridae	<i>Gelochelidon nilotica</i>	Gull-billed Tern	P	
Aves	Laridae	<i>Hydroprogne caspia</i>	Caspian Tern	P	C,J
Aves	Laridae	<i>Sterna hirundo</i>	Common Tern	P	C,J,K
Aves	Laridae	<i>Sterna striata</i>	White-fronted Tern	P	
Aves	Laridae	<i>Sternula albifrons</i>	Little Tern	E1,P	C,J,K
Aves	Laridae	<i>Thalasseus bergii</i>	Crested Tern	P	
Aves	Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	
Aves	Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella	P	
Aves	Cacatuidae	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	P	
Aves	Cacatuidae	<i>^Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V,P,2	
Aves	Cacatuidae	<i>Calyptorhynchus sp.</i>	Unidentified Black-cockatoo	P	
Aves	Cacatuidae	<i>Eolophus roseicapillus</i>	Galah	P	
Aves	Psittacidae	<i>Alisterus scapularis</i>	Australian King-Parrot	P	

Aves	Psittacidae	<i>^Cyclopsitta diophthalma coxeni</i>	Coxen's Fig-Parrot	E4A,P,2	E
Aves	Psittacidae	<i>Glossopsitta pusilla</i>	Little Lorikeet	V,P	
Aves	Psittacidae	<i>Platycercus eximius</i>	Eastern Rosella	P	
Aves	Psittacidae	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	P	
Aves	Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	P	
Aves	Centropodidae	<i>Centropus phasianinus</i>	Pheasant Coucal	P	
Aves	Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	P	
Aves	Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo	P	
Aves	Cuculidae	<i>Cacomantis variolosus</i>	Brush Cuckoo	P	
Aves	Cuculidae	<i>Chalcites basal</i>	Horsfield's Bronze-Cuckoo	P	
Aves	Cuculidae	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	P	
Aves	Cuculidae	<i>Chalcites minutillus</i>	Little Bronze-Cuckoo	P	
Aves	Cuculidae	<i>Cuculus optatus</i>	Oriental Cuckoo	P	
Aves	Cuculidae	<i>Eudynamys orientalis</i>	Eastern Koel	P	
Aves	Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	P	
Aves	Strigidae	<i>^Ninox connivens</i>	Barking Owl	V,P,3	
Aves	Strigidae	<i>Ninox novaeseelandiae</i>	Southern Boobook	P	
Aves	Tytonidae	<i>Tyto javanica</i>	Eastern Barn Owl	P	
Aves	Tytonidae	<i>^Tyto longimembris</i>	Eastern Grass Owl	V,P,3	
Aves	Alcedinidae	<i>Ceyx azureus</i>	Azure Kingfisher	P	
Aves	Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	
Aves	Alcedinidae	<i>Todiramphus chloris</i>	Collared Kingfisher	V,P	
Aves	Alcedinidae	<i>Todiramphus macleayii</i>	Forest Kingfisher	P	
Aves	Alcedinidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher	P	
Aves	Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater	P	J
Aves	Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	P	
Aves	Pittidae	<i>Pitta versicolor</i>	Noisy Pitta	P	

Aves	Climacteridae	<i>Cormobates leucophaea</i>	White-throated Treecreeper	P
Aves	Ptilonorhynchidae	<i>Ailuroedus crassirostris</i>	Green Catbird	P
Aves	Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	P
Aves	Ptilonorhynchidae	<i>Sericulus chrysocephalus</i>	Regent Bowerbird	P
Aves	Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	P
Aves	Maluridae	<i>Malurus lamberti</i>	Variegated Fairy-wren	P
Aves	Maluridae	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	P
Aves	Maluridae	<i>Stipiturus malachurus</i>	Southern Emu-wren	P
Aves	Acanthizidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P
Aves	Acanthizidae	<i>Acanthiza lineata</i>	Striated Thornbill	P
Aves	Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill	P
Aves	Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill	P
Aves	Acanthizidae	<i>Gerygone levigaster</i>	Mangrove Gerygone	P
Aves	Acanthizidae	<i>Gerygone mouki</i>	Brown Gerygone	P
Aves	Acanthizidae	<i>Gerygone olivacea</i>	White-throated Gerygone	P
Aves	Acanthizidae	<i>Sericornis citreogularis</i>	Yellow-throated Scrubwren	P
Aves	Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren	P
Aves	Acanthizidae	<i>Sericornis magnirostra</i>	Large-billed Scrubwren	P
Aves	Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	P
Aves	Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote	P
Aves	Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	P
Aves	Meliphagidae	<i>Anthochaera chrysoptera</i>	Little Wattlebird	P
Aves	Meliphagidae	<i>Caligavis chrysops</i>	Yellow-faced Honeyeater	P
Aves	Meliphagidae	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	P
Aves	Meliphagidae	<i>Lichenostomus fasciocularis</i>	Mangrove Honeyeater	V,P
Aves	Meliphagidae	<i>Lichmera indistincta</i>	Brown Honeyeater	P
Aves	Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	P

Aves	Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	P
Aves	Meliphagidae	<i>Melithreptus albogularis</i>	White-throated Honeyeater	P
Aves	Meliphagidae	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	P
Aves	Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	P
Aves	Meliphagidae	<i>Philemon citreogularis</i>	Little Friarbird	P
Aves	Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird	P
Aves	Meliphagidae	<i>Phylidonyris niger</i>	White-cheeked Honeyeater	P
Aves	Meliphagidae	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	P
Aves	Psophodidae	<i>Psophodes olivaceus</i>	Eastern Whipbird	P
Aves	Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P
Aves	Campephagidae	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	P
Aves	Campephagidae	<i>Coracina tenuirostris</i>	Cicadabird	P
Aves	Campephagidae	<i>Lalage leucomela</i>	Varied Triller	P
Aves	Campephagidae	<i>Lalage sueurii</i>	White-winged Triller	P
Aves	Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	P
Aves	Pachycephalidae	<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	P
Aves	Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler	P
Aves	Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	P
Aves	Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole	P
Aves	Oriolidae	<i>Sphecotheres vieilloti</i>	Australasian Figbird	P
Aves	Artamidae	<i>Artamus cyanopterus</i>	Dusky Woodswallow	P
Aves	Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	P
Aves	Artamidae	<i>Artamus personatus</i>	Masked Woodswallow	P
Aves	Artamidae	<i>Artamus superciliosus</i>	White-browed Woodswallow	P
Aves	Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird	P
Aves	Artamidae	<i>Cracticus tibicen</i>	Australian Magpie	P
Aves	Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	P

Aves	Artamidae	<i>Strepera graculina</i>	Pied Currawong	P	
Aves	Dicruridae	<i>Dicrurus bracteatus</i>	Spangled Drongo	P	
Aves	Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	P	
Aves	Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	P	
Aves	Rhipiduridae	<i>Rhipidura rufifrons</i>	Rufous Fantail	P	
Aves	Corvidae	<i>Corvus coronoides</i>	Australian Raven	P	
Aves	Corvidae	<i>Corvus orru</i>	Torresian Crow	P	
Aves	Monarchidae	<i>Carterornis leucotis</i>	White-eared Monarch	V,P	
Aves	Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	P	
Aves	Monarchidae	<i>Monarcha melanopsis</i>	Black-faced Monarch	P	
Aves	Monarchidae	<i>Myiagra cyanoleuca</i>	Satin Flycatcher	P	
Aves	Monarchidae	<i>Myiagra inquieta</i>	Restless Flycatcher	P	
Aves	Monarchidae	<i>Myiagra rubecula</i>	Leaden Flycatcher	P	
Aves	Monarchidae	<i>Symposiachrus trivirgatus</i>	Spectacled Monarch	P	
Aves	Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin	P	
Aves	Petroicidae	<i>Petroica boodang</i>	Scarlet Robin	V,P	
Aves	Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin	P	
Aves	Petroicidae	<i>Petroica rosea</i>	Rose Robin	P	
Aves	Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola	P	
Aves	Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler	P	
Aves	Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark	P	
Aves	Megaluridae	<i>Megalurus gramineus</i>	Little Grassbird	P	
Aves	Megaluridae	<i>Megalurus timoriensis</i>	Tawny Grassbird	P	
Aves	Timaliidae	<i>Zosterops lateralis</i>	Silvereye	P	
Aves	Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	P	
Aves	Hirundinidae	<i>Hirundo rustica</i>	Barn Swallow	P	C,J,K
Aves	Hirundinidae	<i>Petrochelidon ariel</i>	Fairy Martin	P	

Aves	Hirundinidae	<i>Petrochelidon nigricans</i>		Tree Martin	P	
Aves	Sturnidae	<i>Sturnus tristis</i>	*	Common Myna		
Aves	Sturnidae	<i>Sturnus vulgaris</i>	*	Common Starling		
Aves	Nectariniidae	<i>Dicaeum hirundinaceum</i>		Mistletoebird	P	
Aves	Estrildidae	<i>Lonchura castaneothorax</i>		Chestnut-breasted Mannikin	P	
Aves	Estrildidae	<i>Lonchura punctulata</i>	*	Nutmeg Mannikin		
Aves	Estrildidae	<i>Neochmia temporalis</i>		Red-browed Finch	P	
Aves	Estrildidae	<i>Stagonopleura guttata</i>		Diamond Firetail	V,P	
Aves	Estrildidae	<i>Taeniopygia bichenovii</i>		Double-barred Finch	P	
Aves	Passeridae	<i>Passer domesticus</i>	*	House Sparrow		
Aves	Motacillidae	<i>Anthus novaeseelandiae</i>		Australian Pipit	P	
Mammalia	Ornithorhynchidae	<i>Ornithorhynchus anatinus</i>		Platypus	P	
Mammalia	Tachyglossidae	<i>Tachyglossus aculeatus</i>		Short-beaked Echidna	P	
Mammalia	Dasyuridae	<i>Antechinus stuartii</i>		Brown Antechinus	P	
Mammalia	Dasyuridae	<i>Planigale maculata</i>		Common Planigale	V,P	
Mammalia	Dasyuridae	<i>Sminthopsis murina</i>		Common Dunnart	P	
Mammalia	Peramelidae	<i>Isoodon macrourus</i>		Northern Brown Bandicoot	P	
Mammalia	Peramelidae	<i>Isoodon sp.</i>		Unidentified Brown Bandicoot	P	
Mammalia	Peramelidae	<i>Isoodon/Perameles sp.</i>		unidentified Bandicoot	P	
Mammalia	Peramelidae	<i>Perameles nasuta</i>		Long-nosed Bandicoot	P	
Mammalia	Phascolarctidae	<i>Phascolarctos cinereus</i>		Koala	V,P	V
Mammalia	Vombatidae	<i>Vombatus ursinus</i>		Common Wombat	P	
Mammalia	Petauridae	<i>Petaurus breviceps</i>		Sugar Glider	P	
Mammalia	Petauridae	<i>Petaurus sp.</i>		glider	P	
Mammalia	Pseudocheiridae	<i>Pseudocheirus peregrinus</i>		Common Ringtail Possum	P	
Mammalia	Phalangeridae	<i>Trichosurus caninus</i>		Short-eared Possum	P	
Mammalia	Phalangeridae	<i>Trichosurus sp.</i>		brushtail possum	P	

Mammalia	Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	P	
Mammalia	Potoroidae	<i>Potorous tridactylus</i>	Long-nosed Potoroo	V,P	V
Mammalia	Macropodidae	<i>Wallabia bicolor</i>	Swamp Wallaby	P	
Mammalia	Pteropodidae	<i>Nyctimene robinsoni</i>	Eastern Tube-nosed Bat	V,P	
Mammalia	Pteropodidae	<i>Pteropus alecto</i>	Black Flying-fox	P	
Mammalia	Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V,P	V
Mammalia	Pteropodidae	<i>Pteropus sp.</i>	Flying-fox	P	
Mammalia	Pteropodidae	<i>Syconycteris australis</i>	Common Blossom-bat	V,P	
Mammalia	Rhinolophidae	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat	P	
Mammalia	Molossidae	<i>Austronomus australis</i>	White-striped Freetail-bat	P	
Mammalia	Molossidae	<i>Mormopterus "Species 2"</i>	Undescribed Freetail Bat	P	
Mammalia	Molossidae	<i>Mormopterus sp.</i>	mastiff-bat	P	
Mammalia	Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	P	
Mammalia	Vespertilionidae	<i>Miniopterus australis</i>	Little Bentwing-bat	V,P	
Mammalia	Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V,P	
Mammalia	Vespertilionidae	<i>Myotis macropus</i>	Southern Myotis	V,P	
Mammalia	Vespertilionidae	<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	V,P	
Mammalia	Vespertilionidae	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	P	
Mammalia	Vespertilionidae	<i>Nyctophilus sp.</i>	long-eared bat	P	
Mammalia	Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V,P	
Mammalia	Vespertilionidae	<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	P	
Mammalia	Vespertilionidae	<i>Vespadelus darlingtoni</i>	Large Forest Bat	P	
Mammalia	Vespertilionidae	<i>Vespadelus pumilus</i>	Eastern Forest Bat	P	
Mammalia	Muridae	<i>Hydromys chrysogaster</i>	Water-rat	P	
Mammalia	Muridae	<i>Melomys burtoni</i>	Grassland Melomys	P	
Mammalia	Muridae	<i>Melomys sp.</i>	Unidentified Melomys	P	
Mammalia	Muridae	<i>Muridae sp.</i>	unidentified murid rodent	P	

Mammalia	Muridae	<i>Mus musculus</i>	*	House Mouse		
Mammalia	Muridae	<i>Rattus fuscipes</i>		Bush Rat	P	
Mammalia	Muridae	<i>Rattus lutreolus</i>		Swamp Rat	P	
Mammalia	Muridae	<i>Rattus norvegicus</i>	*	Brown Rat		
Mammalia	Muridae	<i>Rattus rattus</i>	*	Black Rat		
Mammalia	Muridae	<i>Rattus sp.</i>		rat	P	
Mammalia	Canidae	<i>Canis lupus</i>	*	Dingo, domestic dog		
Mammalia	Canidae	<i>Canis lupus familiaris</i>	*	Dog		
Mammalia	Canidae	<i>Vulpes vulpes</i>	*	Fox		
Mammalia	Felidae	<i>Felis catus</i>	*	Cat		
Mammalia	Leporidae	<i>Oryctolagus cuniculus</i>	*	Rabbit		
Mammalia	Bovidae	<i>Bos taurus</i>	*	European cattle		
Mammalia	Balaenopteridae	<i>Megaptera novaeangliae</i>		Humpback Whale	V,P	V
Mammalia	Delphinidae	<i>Peponocephala electra</i>		Melon-headed Whale	P	
Insecta	Nymphalidae	<i>Euploea core</i>		Common Crow		
Gastropoda	Camaenidae	<i>Thersites mitchellae</i>		Mitchell's Rainforest Snail	E1	CE



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/08/14 14:14:00

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

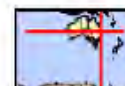
[Acknowledgements](#)



This map may contain data which are
©Commonwealth of Australia
(Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	27
Listed Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	36
Nationally Important Wetlands:	None
Key Ecological Features (Marine):	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area

Listed Threatened Species

[Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Species or species habitat likely to occur within area
Botaurus poeciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Frogs		
Litoria olongburensis Wallum Sedge Frog [1821]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
<u><i>Deonyxus maculatus mitchelliae</i> (SE mainland population)</u>		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
<u><i>Phascogalea cinerea</i> (combined populations of Qld, NSW and the ACT)</u>		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
<u><i>Pseudomys newboldianus</i></u>		
New Holland Mouse, Pockie [95]	Vulnerable	Species or species habitat likely to occur within area
<u><i>Pteropus poliocephalus</i></u>		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Other		
<u><i>Trametes mitchellii</i></u>		
Mitchell's Rainforest Snail [86774]	Critically Endangered	Species or species habitat likely to occur within area
Plants		
<u><i>Acronychia littoralis</i></u>		
Scented Acronychia [8582]	Endangered	Species or species habitat likely to occur within area
<u><i>Allocasuarina deflexa</i></u>		
Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat may occur within area
<u><i>Athysanella hicksonii</i></u>		
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area
<u><i>Balanites nana</i></u>		
Mottled Balanite, Jointed Balanite [8483]	Vulnerable	Species or species habitat may occur within area
<u><i>Cordia alliodora</i></u>		
[17623]	Vulnerable	Species or species habitat likely to occur within area
<u><i>Cryptocarya laetida</i></u>		
Sinking Cryptocarya, Sinking Laurel [11076]	Vulnerable	Species or species habitat may occur within area
<u><i>Cryptocarya laetida</i></u>		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
<u><i>Flindersia australis</i></u>		
Ball Nut, Possum Nut, Big Nut, Beefwood [15762]	Vulnerable	Species or species habitat likely to occur within area
<u><i>Myrtus laetifolia</i></u>		
Sweet Myrtle, Small-leaved Myrtle [78887]	Endangered	Species or species habitat likely to occur within area
<u><i>Phaius australis</i></u>		
Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
<u><i>Rondeletia odorata</i></u>		
Spiny Gardenia [10577]	Endangered	Species or species habitat likely to occur within area
<u><i>Shorea robusta</i></u>		
Shi's Backbone, Shi's Backbone, Isiro Wood [21618]	Endangered	Species or species habitat likely to occur within area
<u><i>Syzygium hookerianum</i></u>		
Smooth-bark Rose Apple, Red Lilly Pilly [3530]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Scaevola roosei Rose Apple, Coolamon, Robby, Durobby, Watermelon Tree, Coolamon Rose Apple (12284)	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Dermis torquata Collared Dermis (1656)	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list		
[Resource Information]		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Arenaria pacifica Fork-tailed Sift (878)		Species or species habitat likely to occur within area
Puffinus pacificus Flesh-footed Shearwater, Flesh-footed Shearwater (1043)		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucorhynchus White-bellied Sea-Eagle (343)		Species or species habitat likely to occur within area
Hirundo lunifrons White-throated Needletail (582)		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater (870)		Species or species habitat may occur within area
Morpho melanocorypha Black-faced Monarch (809)		Species or species habitat known to occur within area
Morpho vivax Speckled Monarch (810)		Species or species habitat known to occur within area
Myiagra cyaneiceps Satin Flycatcher (812)		Species or species habitat known to occur within area
Rhipidura ruficeps Rufous Fantail (582)		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret (50541)		Species or species habitat likely to occur within area
Ardea alba Cattle Egret (50542)		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe (883)		Species or species habitat may occur within area
Strebula banyanensis (banyan snipe) Painted Snipe (883)	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
<u><i>Anas strepera</i></u> Maggie Goose (878)		Species or species habitat may occur within area
<u><i>Acrocyax</i></u> Fork-tailed Sift (878)		Species or species habitat likely to occur within area
<u><i>Ardea alba</i></u> Great Egret, White Egret (50541)		Species or species habitat likely to occur within area
<u><i>Ardea alba</i></u> Cattle Egret (50542)		Species or species habitat likely to occur within area
<u><i>Callinectes hanitschii</i></u> Latham's Snipe, Japanese Snipe (893)		Species or species habitat may occur within area
<u><i>Haliaeetus leucorostus</i></u> White-bellied Sea-Eagle (943)		Species or species habitat likely to occur within area
<u><i>Himantopus caudatus</i></u> White-throated Noddie (582)		Species or species habitat known to occur within area
<u><i>Lathyrus discolor</i></u> Swift Parrot (744)	Endangered	Species or species habitat may occur within area
<u><i>Morone ornatus</i></u> Rainbow Bee-eater (570)		Species or species habitat may occur within area
<u><i>Monarcha melanops</i></u> Black-faced Monarch (500)		Species or species habitat known to occur within area
<u><i>Monarcha melanops</i></u> Spectacled Monarch (510)		Species or species habitat known to occur within area
<u><i>Myiophobus melanops</i></u> Satin Flycatcher (512)		Species or species habitat known to occur within area
<u><i>Pardaliparus melanops</i></u> Capey (552)		Species or species habitat may occur within area
<u><i>Puffinus pacificus</i></u> Flesh-footed Shearwater, Flesh-footed Shearwater (1043)		Species or species habitat likely to occur within area
<u><i>Puffinus pacificus</i></u> Rufous Fantail (502)		Species or species habitat known to occur within area
<u><i>Rhinoptera bonasus</i></u> Painted Snipe (580)	Endangered*	Species or species habitat may occur within

Name	Status	Type of Presence
<u>Rhinella marina</u> Cane Toad [83218]		habitat likely to occur within area Species or species habitat likely to occur within area
Mammals		
<u>Bos taurus</u> Domestic Cattle [16]		Species or species habitat likely to occur within area
<u>Canis lupus familiaris</u> Domestic Dog [82854]		Species or species habitat likely to occur within area
<u>Felis catus</u> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
<u>Lepus sylvaticus</u> Brown Hare [127]		Species or species habitat likely to occur within area
<u>Mus musculus</u> House Mouse [120]		Species or species habitat likely to occur within area
<u>Oryctolagus cuniculus</u> Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
<u>Rattus norvegicus</u> Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
<u>Rattus rattus</u> Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
<u>Sciurus hudsonicus</u> Frog [8]		Species or species habitat likely to occur within area
<u>Vulpes vulpes</u> Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
<u>Amaranthus phioxanthoides</u> Alligator Weed [11620]		Species or species habitat likely to occur within area
<u>Ampelopsis cordifolia</u> Madria Vine, Jalep, Lamb's-tail, Mignonette Vine, Amelena, Gulf Madriavine, Heartleaf Madriavine, Potato Vine [2643]		Species or species habitat likely to occur within area
<u>Asparagus arborescens</u> Asparagus Fern, Ground Asparagus, Basket Fern, Spreng's Fern, Bushy Asparagus, Emerald Asparagus [80425]		Species or species habitat likely to occur within area
<u>Asparagus densiflorus</u> Climbing Asparagus-fern [48903]		Species or species habitat likely to occur within area
<u>Cabomba caroliniana</u> Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
<u>Chrysanthemoides monilifera</u> Blow Bush, Bonemeed [18983]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
<u>Chrysanthemoides monnifera subsp. rotundata</u> Blitou Bush [16332]		Species or species habitat likely to occur within area
<u>Eichhornia crassipes</u> Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
<u>Cenchrus sp. X Cenchrus monosuavatus</u> Broom [67536]		Species or species habitat may occur within area
<u>Lantana camara</u> Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10602]		Species or species habitat likely to occur within area
<u>Pinus radiata</u> Radiata Pine Monterey Pine, Insignis Pine, Widing Pine [20780]		Species or species habitat may occur within area
<u>Polystichum plumosum</u> Climbing Asplenium-fern, Ferny Asplenium [11747]		Species or species habitat likely to occur within area
<u>Sagittaria pterophylla</u> Delta Arrowhead, Arrowhead, Slender Arrowhead [66483]		Species or species habitat likely to occur within area
<u>Salvinia molesta</u> Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
<u>Senecio madagascariensis</u> Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Reptiles		
<u>Hemidactylus frenatus</u> Asian House Gecko [1708]		Species or species habitat likely to occur within area

Coordinates

-28.594 153.548

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- [Natural History museums of Australia](#)
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museum](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Arnhem and Canberra](#)
- [University of New England](#)
- [Open Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

[Environmental Australia](#)
[Department of the Environment](#)
GPO Box 700
Canberra ACT 2601 Australia
Tel: 06029 1111

Threatened Species recorded on the BluesFest site

Table 2.1 Threatened species and communities previously recorded at the Bluesfest site

Common name	Scientific name
Flora	
Durobby	<i>Syzygium moorei</i>
EECs	
Lowland Rainforest on Floodplain	n/a
Subtropical Coastal Floodplain Forest	n/a
Swamp Sclerophyll Forest	n/a
Fauna	
Black Bittern	<i>Ixobrychus flavicollis</i>
Common Blossom Bat	<i>Syconycteris australis</i>
Eastern Bentwing-bat	<i>Miniopterus orianae oceanensis</i>
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>
Eastern Long-eared Bat	<i>Nyctophilus bifax</i>
Eastern Osprey	<i>Pandion cristatus</i>
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Koala	<i>Phascolarctos cinereus</i>
Little Bentwing-bat	<i>Miniopterus australis</i>
Little Eagle	<i>Hieraaetus morphnoides</i>
Southern Myotis	<i>Myotis macropus</i>
Wallum Froglet	<i>Crinia tinnula</i>
Wompoo Fruit-dove	<i>Ptilinopus magnificus</i>
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>

Threatened Species considered for the CAWI dog shelter site (Proposed Lot 1)
NPWS Wildlife Atlas



Common name	Scientific name	Status
Eastern Long-eared Bat	<i>Nyctophilus bifax</i>	V
Eastern Osprey	<i>Pandion cristatus</i>	V
Eastern Tube-nosed Bat	<i>Nyctimene robinsoni</i>	V
Freckled Duck	<i>Stictonetta naevosa</i>	V
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V
Green and Golden Bell Frog	<i>Litoria aurea</i>	E1
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V
Koala	<i>Phascolarctos cinereus</i>	V
Little Bentwing-bat	<i>Miniopterus australis</i>	V
Little Eagle	<i>Hieraaetus morphnoides</i>	V
Little Lorikeet	<i>Glossopsitta pusilla</i>	V
Long-nosed Potoroo	<i>Potorous tridactylus</i>	V
Mitchell's Rainforest Snail	<i>Thersites mitchellae</i>	E1
Olongburra Frog	<i>Litoria olongburensis</i>	V
Pale-vented Bush-hen	<i>Amaurornis moluccana</i>	V
Rose-crowned Fruit-Dove	<i>Ptilinopus regina</i>	V
Scarlet Robin	<i>Petroica boodang</i>	V
Southern Myotis	<i>Myotis macropus</i>	V
Spotted Harrier	<i>Circus assimilis</i>	V
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	V
Wallum Froglet	<i>Crinia tinnula</i>	V
White-eared Monarch	<i>Carterornis leucotis</i>	V
Wompoo Fruit-Dove	<i>Ptilinopus magnificus</i>	V

KEY

E4A Critically endangered

E1 Endangered

V Vulnerable

TABLE 5
COMMONWEALTH EPBC ACT (1999) DATABASE THREATENED FAUNA
SPECIES WITH SUITABLE HABITAT WITHIN 5 KM OF THE SUBJECT SITE

Common Name	Scientific name	Status
Australasian bittern	<i>Botaurus poiciloptilus</i>	E
Australian Painted Snipe	<i>Rostratula australis</i>	V
Black-breasted Button-quail	<i>Turnix melanogaster</i>	V
Black-throated Finch (southern)	<i>Poephila cincta cincta</i>	E
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	V
Collared Delma	<i>Delma torquata</i>	V
Coxen's Fig-Parrot	<i>Cyclopsitta diophthalma coxeni</i>	E
Giant Barred Frog	<i>Mixophyes iteratus</i>	E
Green and Golden Bell Frog	<i>Litoria aurea</i>	V
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V



Common Name	Scientific name	Status
Koala	<i>Phascolarctos cinereus</i>	V
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V
Long-nosed Potoroo (SE mainland)	<i>Potorous tridactylus tridactylus</i>	V
Mitchell's Rainforest snail	<i>Thersites mitchellae</i>	CE
New Holland mouse	<i>Pseudomys novaehollandiae</i>	V
Red Goshawk	<i>Erythrotriorchis radiatus</i>	V
Regent Honeyeater	<i>Xanthomyza phrygia</i>	E
Spotted-tail Quoll (southeastern mainland population)	<i>Dasyurus maculatus maculatus</i> (SE mainland population)	E
Swift Parrot	<i>Lathamus discolor</i>	E
Wallum Sedge Frog	<i>Litoria olongburensis</i>	V
Water mouse	<i>Xeromys myoides</i>	V

KEY

- CE Critically endangered
- E Endangered
- V Vulnerable

APPENDIX F

On-Site Wastewater Assessment



FEASIBILITY ASSESSMENT FOR THE ON-SITE WASTEWATER MANAGEMENT

For

A PROPOSED SUBDIVISION

OF

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP
856832 & Lot 49 DP 881232
Yarun Lane, Tyagarah

For
Byron Shire Council

Report Number: 15112_ww.docx
Date: 12th March 2015

TABLE OF CONTENTS

1.0	INTRODUCTION	3
1.1	PROPOSED DEVELOPMENT	3
1.2	EXISTING DEVELOPMENT	3
1.3	IMMEDIATE CONSTRAINTS	4
2.0	SITE DESCRIPTION	4
2.1	LAND AREA	4
2.2	VEGETATION	4
2.3	SLOPE	4
2.4	SOIL	5
2.5	ENVIRONMENT AND HEALTH RISK ASSESSMENT	7
2.6	SITE CONSTRAINTS AND PROPOSED BEST PRACTICE	8
2.6.1	<i>Proposed Improvements</i>	<i>8</i>
3.0	POTENTIAL ON-SITE WASTEWATER MANAGEMENT	9
3.1	WASTEWATER DISPOSAL FIELD MODELLING	9
3.2	HYDRAULIC LOAD	9
3.3	TREATMENT OPTIONS.....	10
3.4	DISPOSAL FIELD	11
3.5	EASEMENTS, MANAGEMENT AND OTHER CONSIDERATIONS	12
4.0	CONCLUSION	13
5.0	REFERENCES	14

Appendix A Subsurface Disposal Area and Wetland Calculation

LIST OF FIGURES

Exhibit No 1	- Site Location
Exhibit No 2	- Proposed disposal areas
Exhibit No 3	- Suitable species of plants

1.0 INTRODUCTION

Greg Alderson and Associates have been commissioned to undertake a preliminary investigation for possible on-site wastewater management for the commercial rezoning at Lot 2 DP 1159910, Lot 49 DP 881232, Lot 1 DP 713023, Lots 8 and 9 DP 856832, Lot 6 DP 836897 and Lot 2 DP 749851, Yarun Road, Tyagarah.

1.1 Proposed Development

It is proposed that the existing Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232 be subdivided to form 16 new allotments. Eight of these proposed allotments will contain the existing air strip and buildings, seven proposed allotments are to be used for industrial/commercial purposes, and one proposed allotment will preserve vegetation for a koala reserve.

The allotments are proposed to be as follows

Table 1: Proposed Lot Areas

Lot Number	Area (ha)
lot 1	0.0307
lot 2	0.2033
lot 3	0.2558
lot 4	0.1773
lot 5	0.1699
lot 6	0.4552
lot 7	0.1934
lot 8	0.1193
lot 9	0.1042
lot 10	0.5137
lot 11	0.2009
lot 12	0.2096
lot 13	0.259
lot 14	1.06
lot 15	10.33
lot 16	0.215

1.2 Existing Development

The site currently contains various buildings associated with the Tyagarah airfield, which includes various hangers, a sky diving facility and a dwelling. The Tyagarah hall is located within the cluster of buildings.

The buildings are connected to on-site wastewater management systems, and upon an inspection of some of the systems it appears that the systems consist of either septic tanks and absorption trenches or Aerated Wastewater Treatment Systems and mounded disposal fields. The existing Section 68 approvals for the systems were not sought at this as it is considered that

the proposed layout would deem these systems obsolete and an upgrade to the wastewater management systems will be required.

1.3 Immediate Constraints

The site contains features which are limiting to the on-site management of wastewater. These constraints include sandy soils with high water table and within a flood zone. The site is relatively level and at times, can have poor drainage (associated with high water tables and prolonged rain events). The management of wastewater for the site will need to reduce the potential of connection to the groundwater table with wastewater, hence for high treatment of wastewater and the importation of fill is recommended in order to manage wastewater at the site.

Due to the immediate constraints and the proposed layout of the subdivision, it is recommended that a common wastewater management area is used; as such an easement will need to be created over allotments in order to achieve this. Separate wastewater treatment systems would be expected to be utilised at the existing and proposed developments.

2.0 SITE DESCRIPTION

The site has an area of approximately 15ha of varying land use. The Tyagarah air strip and associated hangers and sheds covers most of the proposed development area, while regrowth paper bark forest covers the remainder of the area.

The site is near level, with the water table fluctuating between 0-300mm below the natural ground surface (water monitoring by GAA, 2015). Elevation of the site is generally around 3.0m AHD.

2.1 Land Area

The investigation area covers a land area of approximately 15 hectares. However, not all of this land area is suitable for wastewater management due to:

- Existing vegetation;
- High water table; and
- Existing buildings.

2.2 Vegetation

The site contains varying vegetation communities. Dense, regrowth vegetation exists on the northern side of the access road, and it is understood that this will be reserved for koala habitat. Areas around the existing buildings are well maintained, and are predominantly grasses. The proposed vacant allotments contain dense, long grass.

2.3 Slope

In general the overall site is relatively flat, especially in the vicinity of the existing buildings and the vacant allotments to the north of Tyagarah Lane. The land undulates in the area of regrowth vegetation to the south of Tyagarah Lane. It is understood that this area may contain fill and was created from the levelling of the Tyagarah airfield and possibly the access road.

2.4 Soil

The soil of the site is relatively consistent across the area, being sandy soils. The soil of the site showed a consistent texture throughout the boreholes. The site contains high water table, which at some stages during the investigation, was above the ground level.

The soil texture and the position of the water table deems the site as environmentally sensitive and creates the potential for wastewater to potentially pollute the environment.

Table 2: Summary of soil characteristics recorded from the excavated borehole 1.

Soil	Colour	Sample Depth(m)	Structure and Description
	0		Water table @ 300mm depth
	Black sand		
		0.5 BH1-1	Loamy sand, wet, single grained
	800		
	Grey sand Brown mottles	1.0 BH1-2	sand, wet, single grained
	1200		
	Brown sand		
	1500	1.5 BH1-3	sand, wet, single grained

Table 3: Summary of soil characteristics recorded from the excavated borehole 2.

Soil	Colour	Sample Depth(m)	Structure and Description
	0		Water table @ 200mm depth
	Black sand		
	400	0.5 BH2-1	Loamy sand, wet, single grained
	Brown sand with reddish hue	1.0 BH2-2	sand, wet, single grained
		1.5 BH2-3	sand, wet, single grained
	2000	2.0 BH2-4	sand, wet, single grained

Morand (1994) maps the soil of the proposed development area as being within the 'Tyagarah Aeolian' soil landscape. This soil landscape is described as consisting of deep (>150cm) well drained podzols and acid peats near barrier systems. Geology consists of Quaternary estuarine alluvium overlain by and/or mixed with Quaternary (Pleistocene) sands. Sands are generally Aeolian. However, it is noted that the soil profile is more similar to that of Black Rock's soil profile, as Tyagarah Landscape indicates that sandy clay soil is intersected, whilst Black Rock landscape contains subsoil of light grey, coarse sand, similar to that as observed on the site. Both landscapes are derived from Quaternary (Pleistocene) beach and sand dune, with Tyagarah soil landscape containing estuarine alluvium overlain by and/or mixed with quaternary sands (Morand, 1994).

The following is a summary of the Soil Conservation Service 1:100,000 Soil Landscape Map (1994) Morand (1994, p160).

Soil Landscape:	Aeolian Tyagarah Landscape
Soils:	Deep (>150 cm) Moderately well drained minimal Prairie Soils near basaltic areas. Deep (>150 cm) well drained podzols and acid peats near barrier systems. Deep (>200 cm) well drained Podzols and siliceous sands in landscape variant and deep (>200 cm) poorly drained Peaty Podzols near Tuckean soil landscape
Geology:	Quaternary estuarine alluvium overlain by and/or mixed with quaternary sands
Limitations:	Very acid soils with high aluminium toxicity potential. Steep slopes and mass movement and localised rock outcrop.
Permeability:	moderate to high.

At this stage of the investigation no soil samples were analysed to determine characteristics that would determine suitability for wastewater management. It is considered that in general, this soil (which is typical of this region) is suitable for wastewater management, however, analysis would be required if this option was examined further.

In general, the soils of the site have the following characteristics:

- **pH:** Soil pH is generally acidic (4 to 5.0), and will require lime to be incorporated into the disposal area.
- **Electrical Conductivity (dS/m):** Morand (1994) states that the Tyagarah soil landscape has a low electrical conductivity in the sandy textured soil, and this is similar with the Black Rocks landscape. There was no evidence of vegetation being affected by salt
- **Phosphorous Sorption (kg/ha):** Morand (1994) states that the Tyagarah soil landscape has a moderate to high phosphorous sorption rate of greater than 600mg/kg for both the Ty 1 and Ty2 soil types, which are the most similar in characteristics to that observed at the site. This P sorption rate generally reflects 10000kg/ha/year, which is considered to be adequate in adsorbing phosphorus from the wastewater generated from the development. However, it is not expected that this is a true reflection of the single grained soils at the site, which it is considered due to the low pH and porosity of the soil that phosphorus would potentially be leached and not adsorbed which would make it available for plant uptake. It is expected that the p Sorption value would be lower, and a conservative figure of 1000 kg/ha/year is the default within Council's model. The importation of loam fill to the site to allow for a disposal field above the water table will

increase the P sorption rate, therefore, calculations are based on the use of a higher figure

- Therefore, a conservative P sorption rate should be applied to determine a suitable area for the wastewater system
- **Modified Emerson Aggregate Test:** Morand (1994) states that the Tyagarah soil landscape has a low dispersive percentage, there were no signs of dispersiveness when soil at site was examined
- **Soil Permeability:** The sites soils were sandy clay which are expected to have high permeability rate, albeit at some stages when the water table is high the soils will be saturated
- **Depth of Soil:** The depth of soil varies to greater than 200 cm to no soil where the rock outcrops are exposed. It is expected that coffee rock be found at depth
- **Depth To High Episodic/Seasonal Watertable:** The watertable is variable, with recent observations presenting that the water table fluctuates between 0.3 m below the surface to above ground, due to the low gradient of the sites which creates flooding of the drainage systems, impacting on the water table. A groundwater monitoring bore has been installed on the site at Lot 49 DP 881232.

There are no groundwater bores in close proximity (within 250 m) of the site.

2.5 Environment and Health Risk Assessment

The following is an environment and health risk assessment in accordance with the policy for *Design Guidelines for On-Site Sewage Management Systems* Byron Shire Council (December 2004).

Table 4: Environment and Health Risk Assessment for Proposed Disposal Area

SITE FEATURE	LIMITATION		REASONING
	NONE	MAJOR	
FLOOD POTENTIAL		x	It is understood that the site is subject to flooding
SOIL TYPE	x		The natural soils of the site are sandy based and will have high permeability although will generally have low phosphorus adsorption
EXPOSURE	x		The exposure is relatively good and won't be shadowed until late afternoon by the trees along the creek line
SLOPE %	x		Site is level
LANDFORM	x		Convex side slope
EROSION POTENTIAL	x		No signs of erosion present
SUBSOIL DRAINAGE		x	Subsoil drainage is impeded due to high watertable at the site
SURFACE DRAINAGE		x	There are visible signs of drainage problems at times at the site
LAND FILLING	x		In the most suitable area for disposal, there is no filling (although levelling of the site may have occurred) Some improvements to the soil can be made through top dressing, but over natural soil
LAND AVAILABLE FOR APPLICATION AREA AND BUFFERS	x		There is adequate area available adjacent the existing disposal field, in excess of 10000m2.
ROCKS AND ROCK OUTCROPS	x		No rocks were observed

2.6 Site Constraints and Proposed Best Practice

Table 2 presents site constraints that occur following the BSC On-Site Policy (December, 2004).

The following are considered to be site constraints for this site:

- Soil Type
- Low gradient

2.6.1 Proposed Improvements

The soil type is sandy soil, low lying and it is recommended that for any treatment system or management system that improvements to the soil be undertaken prior to the application of wastewater. The depth of filling required will depend on the treatment system ultimately used (tertiary treatment would require limited importation of fill, versus a secondary treatment system). The purpose of filling will create a buffer to the water table and be mounded to allow for the shedding of rainwater.

Lime is required to be applied to the soil due to the increased acidity of the soils of the site and the effects of acid sulfate soils (refer to separate report by Greg Alderson and Associates 15112_ASS). The increase of pH affects cation exchange capacity which can lead to deficiencies in calcium and magnesium while mobilising aluminium, that is toxic to plants. Lime can be added to the soil profile when preparing the area for disposal to increase the pH to a range between 6.5 – 8.5, which will enable plants to take up nutrients which will be within the wastewater.

Gypsum will be added to the soil on an annual basis at the rate of 1tonne/hectare to prevent the soil from degrading from sodium application, which is contained in the wastewater.

3.0 POTENTIAL ON-SITE WASTEWATER MANAGEMENT

Although the area of the overall site is large, there will be constraints for the management of wastewater on the site, due to high water table, existing vegetation and infrastructure.

3.1 Wastewater Disposal field Modelling

Calculations have been based on Council's wastewater model from the Council's On-Site Wastewater Management Policy (2004) with theoretical wastewater generation loadings from Council's Water and Sewer Equivalent Tenements Policy 12/001 (November 2011).

In general it is considered that these Policies are appropriate to provide a broad overview of area required for the on-site management of wastewater due to theoretical loadings for the as yet, unknown development for the site.

3.2 Hydraulic Load

The estimated hydraulic loading is determined from the Council's Water and Sewer Equivalent Tenements Policy 13/005 (November 2013). This Policy has been used due to the unknown certainty of how large or for what purpose the future buildings at the site may be for. The Sewer Policy (2011) uses a hydraulic loading based on the built up area, in hectares, to determine the equivalent tenement (ET) rate. One ET equate to 590 L/day of wastewater (Byron Sewer Policy 2011).

Table 5: Estimated Hydraulic Loading (sewer ET)

Site	area ha	ET	L/day	Notes
lot 1	0.0307	0.4605	272	
lot 2	0.2033	3.0495	1800	
lot 3	0.2558	3.837	2264	
lot 4	0.1773	2.6595	1569	
lot 5	0.1699	2.5485	1504	
lot 6	0.4552	6.828	4029	
lot 7	0.1934	2.901	1712	
lot 8	0.1193	1.7895	1056	
lot 9	0.1042	1.563	922	
lot 10	0.5137	7.7055	4546	
lot 11	0.2009	3.0135	1778	
lot 12	0.2096	3.144	1855	
lot 13	0.259	3.885	2292	
lot 14	0	0	0	This lot is vacant and will not contribute to sewer loading
lot 15	0.0001	0.0015	0.89	This lot contains the airfield, entire lot is not being considered for wastewater
lot 16	0.215	3.225	1903	
	3.1074	46.6	27500	

Based on the Council's Sewer Policy (13/005) which states an equivalent tenement for sewer is 590 L/day, the estimated hydraulic loading from the proposed subdivision is 27500 L/day.

3.3 Treatment Options

Treatment options are somewhat variable from individual on-site systems to a combined treatment system. Further treatment under trade waste may be required for each of the individual allotments, depending on the type of development.

3.3.1 Individual Treatment Systems

A decentralised system consists of clustered treatment systems and a combined irrigation disposal field for the total development. A decentralised system could consist of individual treatment systems at each of the allotments or a modular treatment system in a common area.

Each allotment could have an individual treatment system, which will treat only the wastewater generated from the development on that allotment. These treatment systems would therefore be specifically suited for the development type, the type of wastewater and the estimated loading from the developments. The smaller systems have reduced ability to treat the wastewater to a very high standard, hence the expected quality from the smaller systems will not have the same nutrient reduction capabilities as a larger treatment system which would receive treatment from all of the development. The individual treatment systems would be able to cater for between 20% to 50% total nitrogen reduction, however the smaller treatment systems are fairly limited in total phosphorus reduction.

Currently the existing treatment systems at the existing development consist of Aerated Wastewater Treatment Systems and Septic Tanks. At this stage no investigation has been undertaken to determine if the locations of these tanks will remain on the subject site and further investigation has not been undertaken to determine if these systems are working as required or if the disposal field will be located on the subject allotment with the proposed subdivision layout.

The benefits of individual treatment systems on each of the allotments would be that the on-going management and maintenance of these systems are directly corresponded to each of the allotments. Therefore any problematic wastewater generation would then only affect that particular treatment system and not the entire system as would occur with a combined treatment system, eg a macadamia processing plant which has emulsified oils that requires a specialist treatment system rather than being managed through the combined system.

In addition, the systems can be installed as the market/development demands rather than installing a larger system at once which may not be required until years later.

3.3.2 Combined Treatment System

However, as stated previously, a larger treatment system will be able to reduce the nutrient levels to a more desirable quality, which will be required to meet tertiary standards and if only limited fill was imported to the site. Such treatment systems are generally utilise membrane filtration to reduce nitrogen and phosphorus to low levels. These systems however are more suited for areas where there is demand and if the site would be developed at the same time as the system are more suitable for a set loading rate.

Typically packaged treatment plants will only treat a range of wastewater generated from a development, as such the packaged treatment plant will be limited to the number of sites that

will be developed over time. That is, a 30000L treatment system will not cope with a significantly lower loading.

Smaller treatment systems that only achieve secondary treatment for about 15000L will be in the order of \$60000 whilst a tertiary plant that could treat the same volume could be in the order of \$300000.

3.4 Disposal field

The site is relatively low lying, has high water table and sandy soils, which generally make it difficult for the disposal of wastewater at the site. However, an engineered approach could be undertaken for the disposal of wastewater at the site which could include the following (or a combination of):

- Tertiary treatment of wastewater to allow for surface irrigation of wastewater and containing treated wastewater in times of flood and/or high water table;
- Importation of fill above the water table and the flood level

Based on the Byron Council Policy (2004), the area for disposal using the following parameters:

- Equivalent of 189 people at 145 L/person/day (27405L/day);
- Depth varying from 0.5 to 2 m depth to watertable depending on volume of imported fill;
- Sandy soils;
- Increased P sorption due to imported fill to 3000 kg/m²
- mounded bed (to allow for imported to the site);
- 9 mm/day absorption rate

Table 6: Disposal Field required

Description	Area Required	Limiting factor
Area required with standard secondary treatment and filled area*	24902 m ²	Nitrogen
Higher Nitrogen treatment (50% TN reduction) and filled area*	15376 m ²	Nitrogen
Tertiary treatment and limited fill	9450 m ²	Phosphorus

*filled area: calculations allow for 2 m to watertable and 3000 kg/ha/m depth for P sorption

The area that offers the least disturbance to existing vegetation is located to the north west of the airstrip. This area is between the existing, regrowth vegetation and contains the occasional shrub and vegetation area, but not as dense as the area to the north. The estimated area available is about 14340 m².

As this area is adjacent to the airstrip it would be recommended that only a small amount of fill be imported to allow for the disposal field to be above the groundwater table, hence it is recommended that the tertiary treatment system be used on the site which requires in the order of 9840 m² based on the information provided to date regarding the site uses and layout. A reserve area will be available also for upgrade to the area or replacement as deemed required.

The area further to the north which consists of regrowth vegetation is suitable to use from a wastewater perspective, provided that filling was undertaken and conditioning of soil through

liming was also done. This area is approximately 17000 m², however as it does contain larger shrubs and various plants it is recommended that further ecological assessment is undertaken it this area will be assessed any further.

3.5 Wastewater Management on Individual Allotments

Individual on-site wastewater management on each of the allotments may be difficult due to the size of the allotments, and therefore as future uses of the allotments are unknown, it is most likely that a common wastewater management area will be required rather than individual wastewater management on each of the proposed allotments.

Calculations have presented that based on a 2000 m² allotment, the use of the site cannot produce more than 1000 L/day as the area required for this disposal is about 500 m² hence the allotment would be limiting.

There are existing sheds and buildings at the site that may only be generating small volumes of wastewater currently. However, the location of the disposal fields for these facilities is not known and due to the proposed layout of the subdivision, new wastewater management systems would most likely to be required as parts of the management systems would be expected to located on neighbouring allotments, which is not suitable scenario.

3.5 Easements, Management and other considerations

A neighbourhood or strata plan would be required to ensure that appropriate maintenance is undertaken and service contracts/agreements are committed to ensure the longevity of the wastewater management system(s).

The wastewater management systems could be clearly defined as being the asset for all of the allotments of the development, and hence will require a sinking fund to be set up for the upkeep and eventual replacement of the wastewater management system.

Other considerations for the management of wastewater at the site may be that an application under Controlled Activities approval may need to be issued by Office of Water due to the works near the groundwater.

In addition to the above, consideration will need to be made to determine if the use of a combined wastewater management system is ancillary to the development or if the system will require to be assessed under designated development.

Also, due to the proximity of the disposal field area to the airstrip, the Civil Aviation Safety Authority (CASA) may need to be contacted to determine that modifications to land may be undertaken in close proximity to the airstrip. If this location is unsuitable then tree clearing within the regrowth area to north of the airstrip is to be further investigated for ecological significance to determine the suitability for wastewater disposal at this location.

4.0 CONCLUSION

A preliminary feasibility investigation has been undertaken for on-site wastewater management for the proposed subdivision of Council owned land at Yarun Lane, Tyagarah.

The investigation has determined that the site has relatively high environmental sensitivity with:

- highwater table;
- sandy soils;
- flood prone land and
- poorly drained area

The site is also limiting in the available land area due to existing built up areas, areas proposed for development and existing vegetation. The unknown future use of the allotments also makes the prediction of wastewater generation difficult for the site, hence the Council's Sewer code (13/005) was used for the assessment.

Based on the known site constraints, it is considered that the best solution for on-site wastewater management at the site will incorporate the use of treatment systems at each of the proposed allotments which is specifically designed to cater for the wastewater generated from that site specific development.

A combined irrigation field for all of the proposed allotments could be utilized, which would consist of imported fill, located in the relatively cleared area to the south of the regrowth vegetation and north of the air strip. Improvements to the area will need to be made with the importation of suitable fill and amelioration for acid sulfate soils for any soil.

Easements and neighbourhood/strata plans will be required to permit wastewater generated from other allotments to be managed on the combined irrigation field on Proposed Lot 16 and to ensure that the combined system components are maintained and managed for the life of the development. Individual service contracts for the relative treatment systems on each of the allotments will need to be provided to ensure that the systems operate as required.

Although no formal investigation was undertaken of each of the existing wastewater management systems at the site, it is expected that the proposed subdivision which will deem some of the wastewater management systems being on neighbouring properties, which is not suitable in their current state and hence an upgrade will be necessary for all of the existing sites.

Further investigation may be warranted under Controlled Activity Approval if required from Office of Water.

5.0 REFERENCES

Byron Shire Council (December, 2004). *Design Guidelines for On-site Sewage Management Systems*. Protecting the Environment and Health of Byron Shire. Technical Guidelines for System Designers.

Central Mapping Authority (1986). Land Information Centre, NSW Department of Lands, Bathurst.

Environment Protection Authority, Dept. of Local Government, Department of Land & Water Conservation and NSW Department of Health (Feb 1998). *Environment and Health Protection Guidelines - On-Site Sewage Management Systems for Single Households*.

Morand, D.T. (1994). *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* Report, Soil Conservation Service of NSW, Sydney.

Morand, D.T. (1994). *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* Map, Soil Conservation Service of NSW, Sydney.

End of Report

Greg Alderson & Associates
Chartered Professional Engineers and Scientist



Source: NSW LPI Spatial Information
Exchange (2015)
Date 6/03/2015
Project No. 15112_sepp55.docx
Scale: NTS

GREG ALDERSON AND ASSOCIATES
ABN 58 594 160 789
133 Scarrabelottis Road Nashua NSW 2479
Phone: (02) 6629 1552
Email: office@aldersonassociates.com.au

Exhibit No. 1. **SITE LOCATION**

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP
856832 & Lot 49 DP 881232,
Yarin Lane, Tyagarah

Byron OSMS Design Model

Version: 15112 on site disposal calcs_2.xlsm

Set Defaults

STEP 1 bedrooms persons

STEP 2 # persons (Grp 1) 189

STEP 3 # persons (Grp 2)

STEP 4 Block size (m2) 140000

STEP 5 Daily effluent flow accord. water supply type

Reticulated supply (bore, spring, creek) 180L/p.d

Reticulated + std. water saving devices 145L/p.d

Roof water harvesting 140L/p.d

Roof water harvesting + std. water sav. 115L/p.d

STEP 6 Toilet Bathroom Laundry Kitchen

STEP 7 Treatment system

Septic (primary treatment only)

AWTS

Septic + single pass sandfilter (SPF)

Septic + SPF, 25% septic return flow

Septic + recirculating sandfilter

Septic + reedbed

STEP 8 P soil sorption accord. soil type

"Alluvial" Soils 1 (dp, mu, my, te) 10,000 kg/ha/m

"Alluvial" Soils 2 (cr) 2,000 kg/ha/m

Red Basaltic Soils (bg, ca, co, el, ew, mb, ro, wo) 10,000 kg/ha/m

Duplex Soils (ba, bi, bu, mi, ni) 8,000 kg/ha/m

Podzol Soils (ab, bo, br, eb, fh, ki, ku, og, po, ty, wy) 1,000 kg/ha/m

STEP 9 Soil texture & structure beneath system

Gravels, Sands Ksat > 3.0m/d

Sandy loams - weakly structured Ksat > 3.0m/d

Sandy loams - massive Ksat 1.4 - 3.0m/d

Loams - high/moderate structured Ksat 1.5 - 3.0m/d

Loams - weakly structured or massive Ksat 0.5 - 1.5m/d

Clay loams - high/mod structured Ksat 0.5 - 1.5m/d

Clay loams - weakly structured Ksat 0.12 - 0.5m/d

Clay loams - massive structured Ksat 0.06 - 0.12m/d

Light clays - strongly structured Ksat 0.12 - 0.5m/d

Light clays - moderately structured Ksat 0.06 - 0.12m/d

Light clays - weak. structured or massive Ksat < 0.06m/d

Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d

Med. to heavy clays - mod. structured Ksat < 0.06m/d

Med. to hvly clays - weak. struct. or massive Ksat < 0.06m/d

DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 10 Water Table/ Bedrock Depth (m) 2.00

STEP 11 % Effective Rainfall 85%

STEP 12 Soil texture in root zone

Coarse Sand

Fine sand, Sandy loams

Loams, Clay loams, Silt

Clay (light, med, heavy)

STEP 13 SSI lateral seepage width (m) 0.60

STEP 14 Calculate (or Ctrl-)

STEP 15 2.00

Minimum effluent application (mm/day/m²) 1.10

35

2076

ETA bed separation 1.40

Nitrogen Report

Nitrogen Report	
N plant uptake (kg/yr)	498.03
Total N-load	508.03kg/yr
N load exceedence	0.00
N load percolated (kg/yr)	10.00
N released (perc+exceed.) (kg/yr)	10.00
Enviro.N limit (kg/yr)	10.00
Nitrogen area (m ²)	24902
Hydraulic area (m2)	5128
ETA trench area	24154.24
ETA trench length (m)	19.39
Number of SSI laterals	2076
beds total plus separating spaces: X Y dimensions = 20.0m x 30.6m	Area = 612 m2

Water balance area (m²) 24902

Phosphorus area (m²) 11340

Water balance area (m²) 24902

Specific Crop Coeff.(grass=1.00) 1.00

% Effective Rainfall 85%

Percolation (mm/d) 9

Avg depth of root zone (m) 0.30

Avg depth bluemetal (etc) in trench below root zone (m) 0.00

Soil Moisture Holding Capacity: saturation & AWC (mm) 114.00 42.00

Permissible percentile exceedence 5.00%

SSI laterals pipe separation (m) 0.60

Avail. Water Capacity (AWC) of root zone 0.14

Default AWC of bluemetal in trench below root zone 0.00

Land Application Type SSI

ETA

Lateral seepage width (m) 0.300

ETA trench separation 2.00

ETA bed separation 1.40

Byron OSMS Design Model

Version: 15112 on site disposal calcs.xlsm

Set Defaults

bedrooms persons

STEP 1

persons (Grp 1) 189

persons (Grp 2)

STEP 2

STEP 3

Buffer to permanent water

Buffer to intermittent water

STEP 4

Block size (m²)

140000

100

145

4.20

50%

0.60

STEP 5

Daily effluent flow accord. water supply type

Reticulated supply (bore, spring, creek) 180L/p.d

Reticulated + std. water saving devices 145L/p.d

Roof water harvesting 140L/p.d

Roof water harvesting + std. water sav. 115L/p.d

Grp1

Grp2

STEP 6

Toilet

Bathroom

Laundry

Kitchen

Wastewater stream

STEP 7

Treatment system

Septic (primary treatment only)

AWTS

Septic + single pass sandfilter (SPF)

Septic + SPF, 25% septic return flow

Septic + recirculating sandfilter

Septic + reedbed

STEP 8

P soil sorption accord. soil type

"Alluvial" Soils 1 (dp, mu, my, te) 10,000 kg/ha/m

"Alluvial" Soils 2 (cr) 2,000 kg/ha/m

Red Basaltic Soils (bg, ca, co, el, ew, mb, ro, wo) 10,000 kg/ha/m

Duplex Soils (ba, bi, bu, mi, ni) 8,000 kg/ha/m

Podzol Soils (ab, bo, br, eb, fh, ki, ku, og, po, ty, wy) 1,000 kg/ha/m

STEP 9

Soil texture & structure beneath system

Gravels, Sands Ksat > 3.0m/d

Sandy loams - weakly structured Ksat > 3.0m/d

Sandy loams - massive Ksat 1.4 - 3.0m/d

Loams - high/moderate structured Ksat 1.5 - 3.0m/d

Loams - weakly structured or massive Ksat 0.5 - 1.5m/d

Clay loams - high/mod structured Ksat 0.5 - 1.5m/d

Clay loams - weakly structured Ksat 0.12 - 0.5m/d

Clay loams - massive structured Ksat 0.06 - 0.12m/d

Light clays - strongly structured Ksat 0.12 - 0.5m/d

Light clays - moderately structured Ksat 0.06 - 0.12m/d

Light clays - weak. structured or massive Ksat < 0.06m/d

Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d

Med. to heavy clays - mod. structured Ksat < 0.06m/d

Med. to hvly clays - weak. struct. or massive Ksat < 0.06m/d

DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 10

Water Table/ Bedrock Depth (m)

2.00

0.5

50

Final area (m²) 15376

Phosphorus area (m²) 11340

Water balance area (m²) 15376

Specific Crop Coeff. (grass=1.00) 1.00

% Effective Rainfall 85%

Percolation (mm/d) 9

Nitrogen Report

N plant uptake (kg/yr) 307.52

Total N-load 317.52kg/yr

N load exceedence 0.00

N load percolated (kg/yr) 10.00

N released (perc+exceed.) (kg/yr) 10.00

Enviro.N limit (kg/yr) 10.00

Nitrogen area (m²) 15376

Hydraulic area (m²) 5128

ETA trench area 14914.48

ETA trench length (m) 19.39

Number of SSI laterals 1282

beds total plus separating spaces: X Y dimensions = 20.0m x 30.6m Area = 612 m²

Avail. Water Capacity (AWC) of root zone 0.14

Default AWC of bluemetall in trench below root zone 0.00

Land Application Type

SSI

ETA

Lateral seepage width (m) 0.300

ETA trench separation 2.00

Minimum effluent application (mm/day/m²) 1.78

35

1282

ETA bed separation 1.40

STEP 11

% Effective Rainfall

Mounded bed

Level bed with grass

STEP 12

Soil texture in root zone

Coarse Sand

Fine sand, Sandy loams

Loams, Clay loams, Silt

Clay (light, med, heavy)

STEP 13

STEP 14

Calculate (or Ctrl-)

STEP 15

Byron OSMS Design Model

Version: 15112 on site disposal calcs_2_tertiary treatment.xlsm

Set Defaults

bedrooms persons

STEP 1

persons (Grp 1) 189

persons (Grp 2)

STEP 2

STEP 3

Buffer to permanent water

Buffer to intermittent water

STEP 4

Block size (m²)

140000

100

Daily effluent flow accord. water supply type

Reticulated supply (bore, spring, creek) 180L/p.d

Reticulated + std. water saving devices 145L/p.d

Roof water harvesting 140L/p.d

Roof water harvesting + std. water sav. 115L/p.d

Grp1

Grp2

STEP 5

STEP 6

Toilet

Bathroom

Laundry

Kitchen

Wastewater stream

STEP 7

Treatment system

Septic (primary treatment only)

AWTS

Septic + single pass sandfilter (SPF)

Septic + SPF, 25% septic return flow

Septic + recirculating sandfilter

Septic + reedbed

STEP 8

P soil sorption accord. soil type

"Alluvial" Soils 1 (dp, mu, my, te) 10,000 kg/ha/m

"Alluvial" Soils 2 (cr) 2,000 kg/ha/m

Red Basaltic Soils (bg, ca, co, el, ew, mb, ro, wo) 10,000 kg/ha/m

Duplex Soils (ba, bi, bu, mi, ni) 8,000 kg/ha/m

Podzol Soils (ab, bo, br, eb, fh, ki, ku, og, po, ty, wy) 1,000 kg/ha/m

Soil texture & structure beneath system

Gravels, Sands Ksat > 3.0m/c

Sandy loams - weakly structured Ksat > 3.0m/d

Sandy loams - massive Ksat 1.4 - 3.0m/d

Loams - high/moderate structured Ksat 1.5 - 3.0m/d

Loams - weakly structured or massive Ksat 0.5 - 1.5m/d

Clay loams - high/mod structured Ksat 0.5 - 1.5m/d

Clay loams - weakly structured Ksat 0.12 - 0.5m/d

Clay loams - massive structured Ksat 0.06 - 0.12m/d

Light clays - strongly structured Ksat 0.12 - 0.5m/d

Light clays - moderately structured Ksat 0.06 - 0.12m/d

Light clays - weak. structured or massive Ksat < 0.06m/d

Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d

Med. to heavy clays - mod. structured Ksat < 0.06m/d

Med. to hvy clays - weak. struct. or massive Ksat < 0.06m/d

DISPERSIVE soil (Modified Emerson Aggregate test)

Wetted depth (m) 0.50

TN% removal 50.0%

Reed bed area (m²) 542.5

BOD target of 20mg/L is

Current Outlet BOD

% Effective Rainfall

Mounded bed

Level bed with grass

STEP 9

STEP 10

STEP 11

STEP 12

Soil texture in root zone

Coarse Sand

Fine sand, Sandy loams

Loams, Clay loams, Silt

Clay (light, med, heavy)

STEP 13

STEP 14

STEP 15

Land Application Type

SSI

ETA

Lateral seepage width (m)

ETA trench separation

Minimum effluent application (mm/day/m²) 2.90

35

788

1.40

Nitrogen Report

Nitrogen Report	
N plant uptake (kg/yr)	63.50
Total N-load	63.50kg/yr
N load exceedence	0.00
N load percolated (kg/yr)	0.00
N released (perc+exceed.) (kg/yr)	0.00
Enviro.N limit (kg/yr)	10.00

Hydraulic area (m²) 5128

SSI laterals pipe separation (m) 0.60

ETA trench separation

Byron OSMS Design Model

Version: individual allotment.xlsm

Set Defaults

STEP 1 **bedrooms** **persons**

STEP 2 # persons (Grp 1) **7** # persons (Grp 2) **1**

STEP 3 Buffer to permanent water Buffer to intermittent water

STEP 4 Block size (m²) **2000** **100**

STEP 5 Daily effluent flow accord. water supply type

Reticulated supply (bore, spring, creek) 180L/p.d
Reticulated + std. water saving devices 145L/p.d
Roof water harvesting 140L/p.d
Roof water harvesting + std. water sav. 115L/p.d

STEP 6 Wastewater stre

STEP 7 Treatment system

Septic (primary treatment only)
AWTS
Septic + single pass sandfilter (SPF)
Septic + SPF, 25% septic return flow
Septic + recirculating sandfilter
Septic + reedbed

STEP 8 P soil sorption accord. soil type

"Alluvial" Soils 1 (dp, mu, my, te) 10,000 kg/ha/m
"Alluvial" Soils 2 (cr) 2,000 kg/ha/m
Red Basaltic Soils (bg, ca, co, el, ew, mb, ro, wo) 10,000 kg/ha/m
Duplex Soils (ba, bi, bu, mi, ni) 8,000 kg/ha/m
Podzol Soils (ab, bo, br, eb, fh, ki, ku, og, po, ty, wy) 1,000 kg/ha/m

STEP 9 Soil texture & structure beneath system

Gravels, Sands Ksat > 3.0m/d
Sandy loams - weakly structured Ksat > 3.0m/d
Sandy loams - massive Ksat 1.4 - 3.0m/d
Loams - high/moderate structured Ksat 1.5 - 3.0m/d
Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
Clay loams - high/mod structured Ksat 0.5 - 1.5m/d
Clay loams - weakly structured Ksat 0.12 - 0.5m/d
Clay loams - massive structured Ksat 0.06 - 0.12m/d
Light clays - strongly structured Ksat 0.12 - 0.5m/d
Light clays - moderately structured Ksat 0.06 - 0.12m/d
Light clays - weak. structured or massive Ksat < 0.06m/d
Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
Med. to heavy clays - mod. structured Ksat < 0.06m/d
Med. to hvy clays - weak. struct. or massive Ksat < 0.06m/d
DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 10 Water Table/ Bedrock Depth (m) **2.00**

Buffer to Water Table (Bwt) (m) **0.5**

Time for accumulation of P (years) **50**

Final area (m²) **497**

Phosphorus area (m²) **420**

Water balance area (m²) **497**

☒ Specific Crop Coeff. (grass=1.00) **1.00**

% Effective Rainfall **65%**

Percolation (mm/d) **9**

STEP 11 % Effective Rainfall

Mounded bed
Level bed with grass

STEP 12 Soil texture in root zone

Coarse Sand
Fine sand, Sandy loams
Loams, Clay loams, Silt
Clay (light, med, heavy)

STEP 13 Land Application Type

SSI
ETA

STEP 14 Calculate (or Ctrl-q)

lateral seepage width **0.60**

ETA trench separation **2.00**

STEP 15

ETA bed separation **1.40**

Minimum effluent application (mm/day/m²) **2.04**

Nitrogen Report

P prod. per person per yr (kg/person/yr) **4.20**

P uptake by plants (Hp) (kg/ha/yr) **10**

P soil sorption (Ps) (kg/ha/m depth) **3000**

N plant uptake (kg/yr) **9.95**

N load exceedence **0.00**

N load percolated (kg/yr) **1.81**

N released (perc+exceed.) (kg/yr) **1.81**

Enviro. N limit (kg/yr) **1.81**

Total N-load **11.76kg/yr**

% black to tot WW in a full system **32%**

% black to tot WW in a full system: TN **70%**

N loss in disposal bed (% reduction) **50%**

wastewater in a full system: TP **40%**

Wetted depth (m) **0.50**

TN% removal **50.0%**

Reed bed area (m²) **22.1**

BOD target of 20mg/L is **3.4m²**

Current Outlet BOD **3.4m²**

Avail. Water Capacity (AWC) of root zone **0.08**

Default AWC of bluemetall in trench below root zone **0.00**

Trench under root zone **0.00**

Soil Moisture Holding Capacity: saturation & AWC (mm) **105.00** **24.00**

Permissible percentile exceedence **5.00%**

SSI laterals pipe separation (m) **0.60**

lateral seepage width **0.60**

ETA trench separation **2.00**

ETA bed separation **1.40**

APPENDIX G

Servicing Advice

GREG ALDERSON & ASSOCIATES

ABN 58 594 160 789

CHARTERED PROFESSIONAL ENGINEERS & SCIENTISTS

REF: 15017_SERVICES_27032015

March 31 2015

GENERAL MANAGER
Byron Shire Council
PO Box 217
MULLUMBIMBY NSW 2782

Attention: Ian McIntosh, Planning Officer, Development Assessment & Compliance

Re: Potential to provide a sewerage connection for a proposed Subdivision of Council Land at Airport Road off Tanner Lane, Tyagarah

Ian,

The following provides a brief description of the opportunities and constraints to provide the proposed subdivision of Council land at Airport Road, Tyagarah, with a reticulated sewer connection.

1 Background

Byron Shire Council is proposing to rezone existing lots at the Tyagarah Airfield being:

- Lot 49 DP881232,
- Lot 2 DP749851,
- Lot 4 & 5 DP805678,
- Lot 8 & 9 DP856832; and
- Lot 6 DP836887.

The rezoning is to allow the subdivision of the land for commercial purposes by the creation of seven lots. At the same time the proposed boundary adjustments and subdivision would create allotments around existing buildings associated with the airport and provide a formal road reserve for the existing access road known as Airport Road. A total of 15 lots are proposed to be created per the attached lot layout plan.

Council has requested investigation of sewage servicing options for the proposed subdivision. The provision of sewer would benefit the proposed residential lots as well as existing uses in the airport precinct including the:

- Public toilets;
- The Parachute, gliding and skydiving businesses; and
- General aviation workshops.

Other uses in Tanner Lane that would also likely be potential users of any sewer scheme should it be provided from the Airport Road site include the:

- Bluesfest site;
- Truck service depot;
- Tyagarah Service Station;
- Vehicle wreckers; and
- Potential existing residents on rural residential land between the site and Brunswick Heads.

Bluesfest have previously held discussions with Byron Shire Council water and sewerage personnel, and we understand were given preliminary advice that a sewer connection would be a possibility once capacity was made available following Construction of the Brunswick Valley sewerage treatment plant (BVSTP).

Scarrabelottis Road NASHUA NSW 2479

P: (02) 6629 1552 F: (02) 6629 1566 E: office@aldersonassociates.com.au

MEMBER OF THE CIVIL COLLEGE, NATIONAL REGISTERED CIVIL ENGINEER, RPEQ 4907

The Bluesfest Festival occurs over the Easter long weekend, but is making application for other events on the site. The Service Station has made applications to Council for development of its land in the past but as yet has not proceeded with a development other than general small upgrades to the service station and its associated shop.

The reason these other developments are relevant for consideration along with the proposed rezoning of land in the Airport Road, is that a sewer rising main from the subject site would pass these developments, and they may become a financial contributor to the scheme.

1.1 Site Description

The site is approximately 14.7 hectares and currently comprises of seven separate titles.

Part of the property is reserved for tree growing and tea tree and other vegetation will remain in some areas. Proposed Lot 14 and the northwest portion of proposed Lot 15 (airstrip) contain native forest vegetation.

The site is essentially flat with minor depressions and rises. Simpsons Creek is located to the east, in which the drainage lines from the site drain to, which continues to the south arm of the Brunswick River.

The site borders a number of properties (see site locality figure). To the west of the site is Tanner Lane and the Pacific Motorway. Airport Road extends from Tanner Lane into the site from the west. The southern portion of the site contains the air strip.

The Old Pacific Highway, now named Tanner Lane and Yarin Lane and has been upgraded and superseded as a highway. The new Pacific Highway, is a divided four lane road. Access to the site is from the Tyagarah Interchange.

2 Available Infrastructure

2.1 Council Sewer

The nearest reticulated sewerage infrastructure to the site is a 375mm diameter DCIL sewer trunk rising main known as 'Pipeline 4'. The trunk main transfers sewage from the former Brunswick Heads Sewage Treatment Plant (BHSTP) to the Brunswick Valley Sewerage Treatment Plant (BVSTP) located at Valances Road, Mullumbimby. Pipeline 4 and the BVSTP were completed in 2010.

At the former BHSTP a new pump station (SP2000) was constructed to transfer the entire Brunswick Head catchment flows via Pipeline 4 trunk main. From SP2000, Pipeline 4 heads south along the old Pacific Highway, then west through a paper road reserve north of Part Lot 2 DP1159910, under the Pacific Highway, then turns north at the northern end of Bashforth's Lane. The pipeline then runs parallel with the western side of the Pacific Highway through Mr Bashforth's land (Lot 11 DP844553), then west under the Brunswick River to the BVSTP.

2.1.1 Strategic Infrastructure Planning

It is understood that flow contributions from Brunswick Heads were based on the *Brunswick Heads Settlement Strategy* (BSC, 2004). This strategy documented areas currently developed and areas available for future development. Populations and flow generation was determined for the Brunswick Heads catchment to 2025 accounting for the permanent population, overnight guests and day-trippers (PB, 2005). Subsequently the pump station (SP2000) at the former BHSTP and pipeline 4 should have been sized to cater for growth in the Brunswick Heads catchment to 2025.

It is noted that the subject site has not been included in the *Brunswick Heads Settlement Strategy* study area, nor has any revised Strategic document been published for this area inclusive of Tyagarah since the original 2004 strategy.

The Tyagarah area is not included in Council's Section 64 Developer Contribution Plan servicing areas.

2.1.2 Byron Shire Council Water Infrastructure Services Branch - Preliminary Advice

A phone discussion was held with Dean Baulch, Council's Principal Engineer Systems Planning, Water Infrastructure Services, on Monday 23 March 2015.

The following was noted from the discussion:

- Council's allowances for future serviced areas of BVSTP has been based on the settlement strategies completed in the early 2000's, with growth forecasts based on these strategies.
- The site (and the majority of the Tyagarah to the north of the site) is currently zoned RU2 - Rural Landscape (or Deferred Matter) and as such has not been incorporated into any planning strategy for residential development.
- Council has not undertaken further strategic planning since 2004 that directs Council to expand the current BVSTP service areas.
- The only potential method for connection to Council's system would be a new trunk main pipeline from the proposed development directly to BVSTP. This would require extensive environmental approvals, acquisition of easements, an underbore of the Brunswick River and pipeline construction through soft ground (as was the case for Pipeline 4). This can be done, however at an expense.
- Further, Council would have to confirm any additional capacity at BVSTP for additional flow generated from the proposed development before this could even be considered a possibility.
- An additional service area requiring a new trunk main is contradictory to Council's approach to consolidate infrastructure as part of the Brunswick Area Sewerage Augmentation Scheme (BASAS). Council would also need to be willing to accept another asset.
- Given the land is currently zoned rural, subject to approval to rezone to commercial, it was concluded that the obvious wastewater management method would be an on-site system, subject to resolution of environmental constraints including high water table, flooding and potential acid sulphate soils.

Note:

A separate wastewater feasibility assessment report has been prepared considering the option of on-site management of wastewater. Sewer flow generation for the subject site has been estimated in the wastewater feasibility assessment.

Given the advice obtained from Council's Water Infrastructure Services Branch it was not considered necessary at this stage to estimate sewer flow generation from adjoining developments to the north of the subject site as potential contributors to a sewerage scheme.

2.2 Water supply

It is likely water supply can be provided from a reticulated system that could be installed from the existing Rous Water system in that locality. It is recommended that advice be sought from Rous Water regarding their specific requirements for water supply to the subdivision.

2.3 Electrical and Telecommunications

It is recommended that Council contact these services providers and request written advice that electrical and telecommunication services can be provided to the lots.

3 Environmental Constraints

3.1 Topography and water table

The site is low lying and ranges between 2.6 to 3m AHD, however, some areas are lower than this as it drains to creeks. The site has high water table (generally $\leq 300\text{mm}$ from natural ground surface). Sewer/wastewater infrastructure would need to be kept at minimum cover to avoid costly below water table excavations.

3.2 Soils

The soil of the site consisted of black silty loam topsoil graduating to coarse grey sand and white/yellow sand in some locations to the extent of the borehole.

Morand (1994) shows that the soil type of the site is classed as 'Tyagarah' in the 'Aeolian Landscape'. The soils are generally a mixture of sediments of estuarine of Aeolian origin. Generally deep ($>200\text{cm}$) siliceous sands.

The geology is Quaternary (Pleistocene) beach and dune sand mixed with quaternary estuarine alluvium (Morand, 1994).

3.3 Acid Sulphate Soils

The Acid Sulphate Soils Planning Map produced by Byron Shire Council presents that the majority of the site consists of Class 3 soils, which require an investigation if the following occur:

Works beyond 1 m below the natural ground surface;

Works by which the water table is likely to be lowered beyond 1m below the natural ground surface.

The Acid Sulphate Soil Risk Map produced by the Soil Conservation Service (1995) for Huonbrook / Brunswick Heads was investigated to give a preliminary insight as to the potential of acid sulfate soils on the site. The site has been determined to have the classification of Low Probability with the landform code Wa2(p) (W = Aeolian; a = sand plain; 2 = 2-4m elevation; (p) = Pleistocene). The depth to acid sulfate materials, if present, is between one and three meters of the ground surface.

For a more detailed discussion on environmental constraints please refer to the Wastewater Feasibility Assessment by this office.

4 Conclusion

Council's current strategic position is that land outside of current and future designated service areas will not be connected to the reticulated sewer system. Should reticulated sewer be pursued for this site, it is first recommended that Council resolve a whether there is a new strategic direction for sewer servicing arrangements of properties south of Brunswick Heads to Tyagarah.

On-site wastewater management is a consideration provided that the disposal area is filled and a high treatment system is utilised. The existing wastewater management systems servicing each of the current buildings would also need to be upgraded to ensure high quality treatment and disposal within a designated disposal area. Potential on-site wastewater management could occur where the allotments are large enough and wastewater generation does not exceed 1000 L/day which would require a disposal field of 500 m² in area.

If there is further information that you require, please contact this office.

Yours faithfully,

Greg Alderson and Associates

Greg Alderson

Chartered Professional Engineer

Attachments: Proposed plan of subdivision

5 **References**

Byron Shire Council, 2004, *Brunswick Heads Settlement Strategy*,

Morand, D.T. (1994). *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet Report*, Soil Conservation Service of NSW, Sydney.

Morand, D.T. (1994). *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet Map*, Soil Conservation Service of NSW, Sydney.

Parsons Brinckerhoff, October 2005, *Brunswick Area Sewerage Augmentation – Environmental Impact Statement (Main Volume)*,

Personal Communication, Dean Baulch, Council's Principal Engineer Systems Planning, Water Infrastructure Services, Monday 23 March 2015

APPENDIX H

Preliminary Acid Sulfate Soil Assessment



PRELIMINARY ACID SULFATE SOIL ASSESSMENT

For

A PROPOSED SUBDIVISION

OF

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 &
Lot 49 DP 881232
Yarin Lane, Tyagarah

For
Byron Shire Council

Report Number: 15112_ass
Date: 25th February 2015

Table of Contents

EXECUTIVE SUMMARY	3
1.0 INTRODUCTION	4
1.1 SITE IDENTIFICATION.....	4
1.2 SITE DESCRIPTION	4
1.3 PROPOSED DEVELOPMENT.....	4
2.0 ACID SULFATE SOIL ASSESSMENT	4
2.1 PRELIMINARY ASSESSMENT	4
2.2 NUMBER OF SAMPLING SITES	5
2.3 SAMPLING DEPTH	5
2.4 BOREHOLE SAMPLE LOCATION.....	5
2.5 ANALYSIS OF SOIL SAMPLES.....	5
3.0 GEOLOGY AND SOIL	6
4.0 BASIS FOR ASSESSMENT CRITERIA.....	7
5.0 RESULTS.....	7
5.1 INTERPRETATION OF RESULTS	7
6.0 MANAGEMENT	8
7.0 CONCLUSIONS	9
8.0 REFERENCES.....	10

Attachments

Soil laboratory analysis results
Chain of Custody form
Exhibit 1 – Site Location
Exhibit 2 – Soil Sample Point Locations
Exhibit 3 – Site Classification

EXECUTIVE SUMMARY

Greg Alderson and Associates have been commissioned by Byron Shire Council to undertake a preliminary Acid Sulfate Soil (ASS) assessment at Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah, in order to determine if acid sulfate soils are present in the investigation area. It is understood Council has requested this assessment as they are proposing to subdivide the Lots for industrial/commercial use.

The Acid Sulfate Soil Risk Map (1995) indicated that the site is located within an area which was classified with low probability (1-3m below the ground surface), and with the landform code Wa2(p) (W = Aeolian; a = sand plain; 2 = 2-4m elevation; P = Pleistocene). Byron Shire Council's acid sulfate Planning map classes the site as Class 3, requiring investigations for any works below 1m of the natural ground surface or for any works by which the watertable is likely to be lowered beyond 1m of the natural ground surface. Subsequently an assessment of the Actual and Potential Acid Sulfate soils at the site is required as earthworks associated with possible future development of the proposed Lots will likely be beyond 1m of the natural ground surface.

No 'hot spots' or sensitive areas obviously affected by acid sulfate soils were evident within the area proposed to be subdivided. Two boreholes were excavated at the site with the results compared with the Action Criteria within the Acid Sulfate Soil Manual (Stone *et al.*, 1998). Seven samples were collected at 0.5m intervals to a depth of 2.0m and delivered to the Laboratory for analysis.

The laboratory results indicated that there is actual and potential ASS present generally across the entire site. As a preliminary estimate, it was assumed that the proposed development would disturb > 1000 tonnes of soil, leading to the use of the more conservative action criteria values which trigger the requirement to manage disturbed soils. Although both actual and potential ASS were determined to be present in the soil profile, the acid concentrations were considered to be comparatively low for ASS's and development is not prohibited by their presence.

Liming of disturbed soils would be considered to be an effective means of managing ASS. Liming rates provided from soil analysis results could be used for works associated with the proposed subdivision, however it is recommended that a detailed ASS management plan be prepared prior to a construction certificate being issued for civil works associated with the proposed subdivision.

1.0 INTRODUCTION

Greg Alderson and Associates have been commissioned by Byron Shire Council to undertake a preliminary ASS assessment at Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah in order to determine if Acid Sulfate Soil's (ASS) are present in the soil profile within the area proposed to be subdivided.

1.1 Site Identification

The site is formally identified as Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah.

Latitude and Longitude of the center of the proposed subdivision area were sourced from NSW LPI Spatial Information Exchange. The center of the proposed development area is located at Lat -28.594866 and Long 153.546625. A locality plan is provided in **Exhibit No. 1**.

1.2 Site Description

The site has an area of approximately 15ha of varying land use. The Tyagarah air strip and associated hangers and sheds covers most of the proposed development area, while regrowth paper bark forest covers the remainder of the area. The site is near level, with the water table fluctuating between 0-300mm below the natural ground surface (water monitoring by GAA, 2015). Elevation of the site is generally around 3.0m AHD.

1.3 Proposed Development

It is proposed that the existing Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232 be subdivided to form 16 new allotments. Eight of these proposed allotments will contain the existing air strip and buildings, seven proposed allotments are to be used for industrial/commercial purposes, and one proposed allotment will preserve vegetation for a Koala reserve. Soil disturbance associated with the proposed subdivision will include civil works for new roads, and infrastructure for stormwater, presumably sewer, electricity and water supply. The purpose of this investigation is to determine the presence of ASS and the extent and severity if present.

2.0 ACID SULFATE SOIL ASSESSMENT

This investigation is preliminary and is required to determine if potential or actual ASS is present in the soil within the proposed development area. The sampling, analysis and interpretation of data in relation to acid sulfate soils in this report are in accordance with the requirements outlined in the 'Acid Sulfate Soils Manual' endorsed by the Acid Sulfate Soils Management Advisory Committee (ASSMAC) in 1988 (Stone *et al.*, 1988).

Soil sampling methodology used in this investigation included:

- Sample collection by Wendy Attrill (BAppSc) and Dylan Brooks (BEnvSc), both of this office;
- All samples were collected using a hand auger, placed in a plastic bag and sent to the Environmental Analysis Laboratory (EAL) who undertook analysis for the investigation of acid sulfate soil;
- All results from the EAL were sent to this office for the completion of the report;
- The report is written in accordance with the relevant chapters of the 'Acid Sulfate Soils Manual' (Stone *et al.*, 1988).

2.1 Preliminary Assessment

The Acid Sulfate Soil Risk Map (1995) for Huonbrook-Brunswick was investigated to give a preliminary insight as to the potential of acid sulfate soils on the site. The Acid Sulfate Soil Risk Map

(1995) indicated that the site is located within an area classified as low probability (1-3m below the ground surface), and with the landform code Wa2(p) (W = Aeolian; a = sand plain; 2 = 2-4m elevation; P = Pleistocene).

Exhibit No. 3 is an excerpt of the Huonbrook - Brunswick Acid Sulfate Soil Risk Map and illustrates the classification of the site.

2.2 Number of Sampling Sites

Table 4.1 of Section 4a of the Assessment Guidelines (Chapter 2) of the Acid Sulfate Soil Manual (Stone *et al.*, 1998) recommends the minimum number of sampling holes required, which is 4 holes for up to 1hectare. One sample hole was collected in the proposed building site at the location shown on **Exhibit No. 2**. Due to the site having a total area of 5200m², it is considered that one sample represents the area sufficiently as it was collected in point with the lowest elevation across the site.

2.3 Sampling Depth

The depth of soil sampling was determined from Section 4b of the Assessment Guidelines (Chapter 2) of the Acid Sulfate Soil Manual (Stone *et al.*, 1998). The minimum depth of sampling should be at least one metre beyond the depth of the proposed excavation or the estimated drop in water table height, whichever is greatest. As the greatest depth of excavation on the site was not known but considered to be not more than 1.5m, Samples were to be collected to a depth of 2.5m. Section 4b (Stone *et al.*, 1998) also indicates that samples should be collected every 0.5m or for every soil layer.

The nominated depth could not be achieved. This is due to the water table siting less than 0.3m from the natural ground surface, combined with the sand texture of the soil profile, which resulted in slumping of the borehole after a depth of approximately 1.5m.

2.4 Borehole Sample Location

The boreholes were excavated in two different locations of the proposed development area. Samples were collected at 0.5m intervals (Table 1), or where the soil layer changed. The borehole depths went down to 1.5m and 2.0m, which is thought to be deeper than any disturbance associated with any works associated with the proposed development.

Table 1. Soil sample depths.

Borehole 1		Borehole 2	
Sample reference	Depth(m)	Sample reference	Depth(m)
BH1-1	0.5	BH2-1	0.5
BH1-2	1.0	BH2-2	1.0
BH1-3	1.5	BH2-3	1.5
		BH2-4	2.0

Refer to **Exhibit No. 2** for the borehole location.

2.5 Analysis of Soil Samples

The soil samples were analysed for Chromium Reducible Sulfur (CRS) with Method 22B of the Acid Sulfate Soils Assessment and Management Guidelines (in the Acid Sulfate Soil Manual (Stone *et al.*, 1998). The full laboratory analysis results of the soil analysis are presented in the Appendix.

3.0 GEOLOGY AND SOIL

The soil of the site showed a consistent texture throughout the boreholes. The following (Tables 2 & 3) presents a summary of the borehole investigations:

Table 2: Summary of soil characteristics recorded from the excavated borehole 1.

Soil	Colour	Sample Depth(m)	Structure and Description
	0		Water table @ 300mm depth
	Black sand		
		0.5 BH1-1	Loamy sand, wet, single grained
	800		
	Grey sand Brown mottles	1.0 BH1-2	sand, wet, single grained
	1200		
	Brown sand		
	1500	1.5 BH1-3	sand, wet, single grained

Table 3: Summary of soil characteristics recorded from the excavated borehole 2.

Soil	Colour	Sample Depth(m)	Structure and Description
	0		Water table @ 200mm depth
	Black sand		
		0.5 BH2-1	Loamy sand, wet, single grained
	400		
	Brown sand with reddish hue	1.0 BH2-2	sand, wet, single grained
		1.5 BH2-3	sand, wet, single grained
	2000	2.0 BH2-4	sand, wet, single grained

Morand (1994) maps the soil of the proposed development area as being within the 'Tyagarah Aeolian' soil landscape. This soil landscape is described as consisting of deep (>150cm) well drained podzols and acid peats near barrier systems. Geology consists of Quaternary estuarine alluvium overlain by and/or mixed with Quaternary (Pleistocene) sands. Sands are generally Aeolian.

4.0 BASIS FOR ASSESSMENT CRITERIA

The results of the soil sample analysis are compared with the Action Criteria for % Chromium Reducible Sulfur (or Sulfur oxidisable) given in the Acid Sulfate Soil Manual (Stone *et al.*, 1998) (Table 4). If the net acidity is greater than the Action Criteria then this indicates acid sulfate soils are present (potential or actual) and require management. The values for >1000t of disturbed soil has been used.

Table 4: Action Criteria from Section 4.3 of Chapter 2 of the Acid Sulfate Soil Manual (Stone *et al.*, 1998)

Soil Texture	Net acidity (mole H ⁺ /tonne)
Coarse	18
Medium	36
Fine	62

Soils were classed as PASS as per QUASSIT Guidelines, which are presented in Table 5. If the unoxidised Sulfur concentrations exceeded those values in Table 5, the soil was classed as PASS.

Table 5: Classification of PASS as per QUASSIT guidelines

Soil Texture	Reduced Inorganic Sulfur	
	%Scr	mole H ⁺ /tonne
Coarse	≥ 0.03	19
Medium	≥ 0.06	37
Fine	≥ 0.1	62

Soils were classed as ASS if the pH was lower than ≤ 4 (Southern Cross Geoscience, 2012) and if there was inorganic sulphur material present.

5.0 RESULTS

A site plan is provided in **Exhibit No. 2**, presenting soil test locations. The following presents a summary of the soil analysis results from the soil samples collected by this office (Table 5). The full copies of the analysis results are also attached to this report.

Table 6: Summary of Results of Acid Sulfate Soil Analysis

Sample Code	Reduced Inorganic Sulphur (mole H ⁺ /kg)	TAA pH	TAA (mole H ⁺ /kg)	Net Acidity (mole H ⁺ /kg)
BH1-1	7	5.03	13	20
BH2-2	6	4.59	22	28
BH1-3	19	4.95	17	36
BH2-1	4	4.87	18	22
BH2-2	6	5.33	5	12
BH2-3	16	5.07	12	28
BH2-4	11	5.03	11	21

For the full results see the laboratory results sheet attached.

5.1 Interpretation of Results

The results of the soil analysis are compared with the Action Criteria (Stone *et al.*, 1998) (Table 5). The Action Criteria determine when management is required for ASS that are disturbed, and are based on net acidity.

Laboratory results indicate that actual Acid sulfate soils are present within the tested soil profiles at this site. ASSMAC (Stone, Ahern & Blunden, 1998) does state that pH values of between 4 and 5.5 do

not confirm the presence of ASS as acidity may be due to the oxidation of a limited amount of sulphides or the presence of aluminium or hydrogen ions at these pH values. However as both soil profiles show reduced inorganic sulphur at depth, this indicates that the source of acidity is partly or wholly from oxidized sulphur.

Generally the acidity found across the site was low for ASS. No pH values of below 4 were detected, however net acidity of actual and potential sources within the soil meant that the Action criteria triggering the need for management was breached six of the seven soil samples collected (BH1-1, 2 & 3 & BH2-1, 3 & 4). Reduced inorganic sulphur was in concentrations greater than the Action criteria in one soil sample (BH1-3), being at 1.5m depth, and was high at this depth in the other borehole, indicating there is a layer of PASS across the site at 1.5m. Actual ASS is present above and below this layer of PASS.

6.0 MANAGEMENT

If possible, it is recommended that alternative locations for development be pursued in areas free of acid sulfate soils. Due to the presence of the shallow water table and ASS, the site is considered to be environmentally sensitive, and is ideally not disturbed.

All projects should consider ASS if they involve earthworks or disturbances to groundwater hydrology and/or surface drainage patterns, regardless of the project size. Small disturbances in high-risk areas can have considerable impact without appropriate management strategies, particularly if a number of smaller disturbances are occurring simultaneously in a catchment. Cumulative impacts from a number of smaller disturbances need to be considered.

Notwithstanding the above comment, it is considered that the ASS can be managed on the site to limit potential negative impacts from the disturbance of ASS. In accordance with the mitigation and management strategies outlined in chapter 3 of the ASSMAC (Stone, Ahern & Blunden, 1998) guidelines, the following mitigation approaches are recommended for this site:

- For disturbed soils between 0-1.0m of the natural ground surface, acid is to be neutralized through the application of lime at a rate of 2.1kg of pure CaCO_3 (NV 100%)/tonne dry weight of soil, which equates to **2.9 kg ag lime/m³**. Water from disturbed soils is not to leave the site;
- Soil between 1.0-2.0m of the natural ground surface is likely PASS and disturbance is to be avoided at all reasonable cost. If this soil is disturbed, it should be done so in the smallest time frame possible. If material at this depth requires removal, it is to be placed elsewhere on the site below the permanent water table (below 1.0m of the natural ground surface). Acid neutralization is to occur if material is disturbed at this depth and cannot be quickly placed under the permanent water table to limit oxidation. Acid is to be neutralized through the application of lime at a rate of **3.6 kg ag lime/m³**.
- If any natural soil is required to be excavated. Lime is to be mixed at the rate specified above within an appropriately bunded area to ensure no erosion of PASS material or lime occurs and enters the environment
- Any excavated material is to be placed adjacent to the excavation away from direct stormwater flow and within a secure bunded area. Material shall be limed at the specified rate and thoroughly mixed by rotary hoe or similar mixing device to achieve a homogenous

mix, care should be taken in order to reduce the time of mixing, as this will affect the oxidisation

- The storage and handling of lime products shall be in accordance with OH&S procedures and the manufacturer's instructions
- Records shall be kept on site during construction and be available for inspection by the Engineer, Council or State Government officers
- Precautions during the application of lime are required; erosion control techniques are to be employed at all times and no work to be undertaken during wet days or days of high wind
- It is recommended that this is supervised by suitably qualified people.

Upon approval of the proposed subdivision development application detailed information is to be provided on the soil disturbance duration and nature so that mitigation measures can be tailored to suit. It may be possible that if the watertable is below the depth of disturbance, and the duration of disturbance is short, in some instances no mitigation action may be required. Furthermore, if it is determined that less than 1000 tonnes of natural soil is to be disturbed, the action criteria changes and soils from 0.5-1.0m depth is then not required to be managed for mitigating ASS. A detailed management plan would be required prior to the approval of a construction certificate to outline the detailed mitigation requirements to be implemented.

As stated, soil below a depth of 2.0m was not investigated in this assessment. If the proposed ground works associated with the proposed development disturb soils greater than 2m in depth, further investigation will be required to determine the presence of ASS.

7.0 CONCLUSIONS

A preliminary Acid Sulfate Soil Assessment was undertaken at Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP 856832 & Lot 49 DP 881232, Yarin Lane, Tyagarah. This assessment is required to determine if the proposed subdivision area contains acid sulfate soils, and if so to what severity.

Two boreholes were excavated at the site with the results compared with the Action Criteria within the Acid Sulfate Soil Manual (Stone *et al.*, 1998). Although both actual and potential ASS were determined to be present in the soil profile, the acid concentrations were considered to be comparatively low for ASSs and mitigation through neutralization and limited disturbance is adequate for managing ASS.

Liming rates provided from soil analysis results could be used for works associated with the proposed subdivision, however it is recommended that a detailed ASS management plan be prepared prior to a construction certificate being issued for civil works associated with the proposed subdivision.

8.0 REFERENCES

Morand, D.T., 1994. *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* Map, Soil Conservation Service of NSW, Sydney.

Soil Conservation Service of NSW, 1995. Acid Sulfate Soil Risk Map; Pottsville (9640-S-4).

Stone, Y., Ahern, C.R. and Blunden, B., 1998. Acid Sulfate Soils Manual. Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia.

SOIL LABORATORY ANALYSIS RESULTS

RESULTS OF ACID SULFATE SOIL ANALYSIS

7 samples supplied by Greg Alderson & Associates on 28th January, 2015 - Lab. Job No. D9216

Analysis requested by Wendy Attrill. **Your Project: 15112**

(133 Scarrabelottis Road NASHUA NSW 2479)

Sample Site	EAL lab code	TEXTURE (note 7)	MOISTURE CONTENT		TITRATABLE ACTUAL ACIDITY (TAA) (To pH 6.5)		REDUCED INORGANIC SULFUR (% chromium reducible S)		NET ACIDITY Chromium Suite mole H ⁺ /tonne	LIME CALCULATION Chromium Suite kg CaCO ₃ /tonne DW
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH _{KCl}	(mole H ⁺ /tonne)	(%Scr)	(mole H ⁺ /tonne)	(based on %Scr)	(includes 1.5 safety factor when liming rate is +ve)
<i>Method Info.</i>					<i>(ACTUAL ACIDITY-Method 23)</i>		<i>(POTENTIAL ACIDITY-Method 22B)</i>		<i>note 5</i>	<i>note 4 and 6</i>
BH1-1 28/01/15	D9216/1	Coarse	18.9	0.2	5.03	13	0.012	7	20	1.5
BH1-2 28/01/15	D9216/2	Medium	17.9	0.2	4.59	22	0.009	6	28	2.1
BH1-3 28/01/15	D9216/3	Coarse	22.3	0.3	4.95	17	0.031	19	36	2.7
BH2-1 28/01/15	D9216/4	Coarse	21.1	0.3	4.87	18	0.006	4	22	1.6
BH2-2 28/01/15	D9216/5	Coarse	19.4	0.2	5.33	5	0.010	6	12	0.9
BH2-3 28/01/15	D9216/6	Coarse	20.2	0.3	5.07	12	0.025	16	28	2.1
BH2-4 28/01/15	D9216/7	Coarse	20.9	0.3	5.03	11	0.017	11	21	1.6

NOTE:

- 1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)
- 2 - Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (Scr - Method 22B)
- 3 - Methods from Ahern, CR, McElnea AE, Sullivan LA (2004). **Acid Sulfate Soils Laboratory Methods Guidelines**. QLD DNRME.
- 4 - Bulk Density is required for liming rate calculations per soil volume. Lab. Bulk Density is no longer applicable - field bulk density rings can be used and dried/ weighed in the laboratory.
- 5 - **ABA Equation: Net Acidity = Potential Sulfidic Acidity (ie. Scr or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF (with FF currently defaulted to 1.5)**
- 6 - The neutralising requirement, lime calculation, includes a 1.5 safety margin for acid neutralisation (an increased safety factor may be required in some cases)
- 7 - For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays
- 8 - .. denotes not requested or required. '0' is used for ANC and Snag calcs if TAA pH <6.5 or >4.5
- 9 - SCREENING, CRS, TAA and ANC are NATA accredited but other SPOCAS segments are currently not NATA accredited
- 10- Results at or below detection limits are replaced with '0' for calculation purposes.
- 11 - **Projects that disturb >1000 tonnes of soil, the ≥0.03% S classification guideline would apply (refer to acid sulfate management guidelines).**
- 12 - Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.



(Classification of potential acid sulfate material if: coarse Scr≥0.03%S or 19mole H⁺/t; medium Scr≥0.06%S or 37mole H⁺/t; fine Scr≥0.1%S or 62mole H⁺/t) - as per QUASSIT Guidelines

checked:
Graham Lancaster
Laboratory Manager

CHAIN OF CUSTODY FORMS

CHAIN OF CUSTODY FORM

Sheet 1 of 1

INVESTIGATOR: GREG ALDERSON AND ASSOCIATES PTY. LTD. ABN 60 059 559 8558 Scarrabelottis Rd, Nashua 2479 Ph: 02 6629 1552 Fax: 02 6629 1566 E-mail: office@aldersonassociates.com.au Contact: <i>Wendy Atwill</i>		Container Plastic Bag Plastic Bottle Glass Bottle		Sample Matrix Soil Soil Composite Water Other		Sample Preservation Esky Esky & Ice Other		SITE: 15112	
								COURIER: US	
								LABORATORIES: EAL	
								Contact: <i>Gritham Lancaster</i>	
								Laboratory Analysis Required	
Sample ID	Date of Collection							AS-PACK-001 - Chromium suite	
BH1-1	28/01/15	☒		☒		☒		"	
BH1-2	"	☒		☒		☒		"	
BH1-3	"	☒		☒		☒		"	
BH2-1	"	☒		☒		☒		"	
BH2-2	"	☒		☒		☒		"	
BH2-3	"	☒		☒		☒		"	
BH2-4	"	☒		☒		☒		"	
Investigator: I attest that the proper field sampling procedures were used during the collection of these sample/s. Signed: <i>[Signature]</i>									
Relinquished by:	<i>[Signature]</i>	Date:	28/01/15	Time:	4:00	Received by:	<i>Kulibity</i>	Date:	28-01-15
Relinquished by:		Date:		Time:		Received by:		Date:	
Relinquished by:		Date:		Time:		Received by:		Date:	

Sampler Name (print): *Dylan Brooks*

Date: 28/01/15

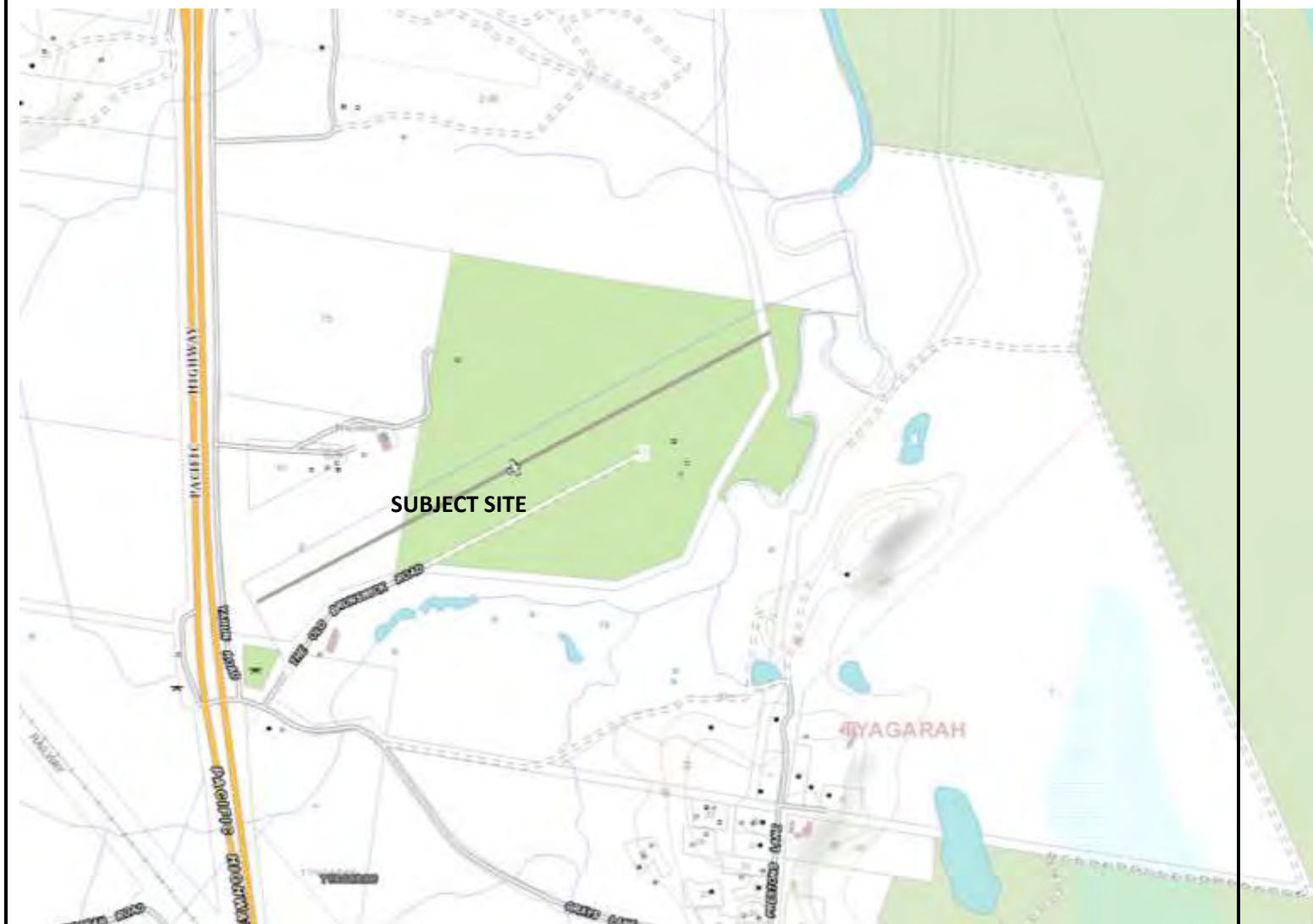
Received by:

Kulibity

Date:

Received by:

Date:

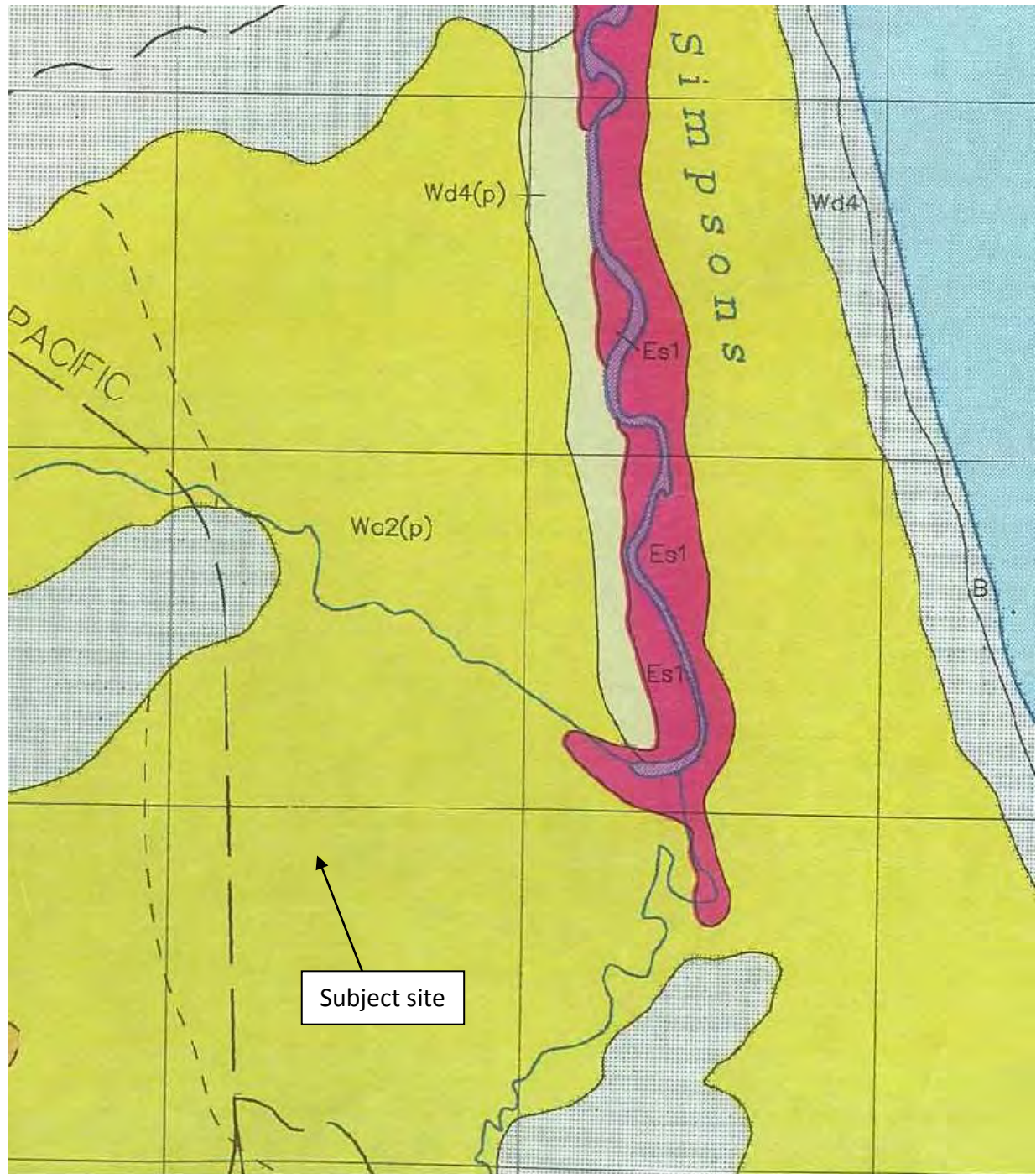


Source: NSW LPI Spatial Information
Exchange (2015)
Date 6/03/2015
Project No. 15112_sepp55.docx
Scale: NTS

GREG ALDERSON AND ASSOCIATES
ABN 58 594 160 789
133 Scarrabelottis Road Nashua NSW 2479
Phone: (02) 6629 1552
Email: office@aldersonassociates.com.au

Exhibit No. 1. **SITE LOCATION**

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887, Lots 8 & 9 DP
856832 & Lot 49 DP 881232,
Yarin Lane, Tyagarah



Source: NSW LPI Spatial Information
Exchange (2015)
Date 4/03/2015
Project No. 15112_ass
Scale: NTS

GREG ALDERSON AND ASSOCIATES
ABN 58 594 160 789
Scarrabelottis Road Nashua NSW 2479
Phone: (02) 6629 1552
Email: office@aldersonassociates.com.au

Exhibit No. 1.
SITE LOCATION

Lot 1 DP 713023, Lot 2 DP 749851, Lot 6 DP 836887,
Lots 8 & 9 DP 856832 & Lot 49 DP 881232,
Yarin Lane, Tyagarah